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VOL. 25. Ser. A. Part 1. pp. 1–56. JANUARY, 1937.

I

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

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REVIEW

OF

APPLIED ENTOMOLOGY.

SERIES A.

VOL. 25. 1937.

MELLANBY (K.). **Humidity and Insect Metabolism.**—*Nature* **138** p. 124, 7 refs. London, 18th July 1936.

Work by Buxton [*R.A.E.*, A **18** 517] indicated that at 23°C. [73·4°F.] the mealworm [*Tenebrio molitor*, L.] used up its reserves more rapidly in dry air than in moist and compensated for evaporation from its body by the production of metabolic water, but from the results of experiments with this and other insects, including bed-bugs [*Cimex lectularius*, L.], [B **23** 136], clothes moths [*Tineola biselliella*, Humm.], [A **22** 543], and adults and pupae of tsetse flies [*Glossina*], the author concludes that the rate of metabolism is governed by temperature, and unaffected by changes in humidity.

For every molecule of metabolic water produced, at least one molecule of oxygen must be taken in, and under dry conditions more water is lost by the evaporation that accompanies respiration than is gained by metabolism. This has been shown by analysing insects that have been subjected to low humidities, and by the fact that many insects are more susceptible to dessication at high temperatures (where metabolism is actually increased) than at low temperatures.

CARROLL (J.). **The Raspberry Beetle** (*Byturus tomentosus*) **and its Control.**—*J. Dep. Agric. Irish Fr. St.* **34** no. 1 pp. 119–123. Dublin, June 1936.

Byturus tomentosus, F., did not attract much attention in the Irish Free State until 1932, but caused extensive damage in 1933 and 1934 in a district where raspberries are extensively grown. An account is given of its life-history and the damage it does [*R.A.E.*, A **19** 638]. In 1934, spraying experiments were carried out on raspberries in which suspensions of 4 types of derris were used, *viz.*, 2 proprietary derris powders (to which coconut oil soap was added) and 2 proprietary derris preparations containing spreaders. All the suspensions were made

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to contain 0·005 per cent. rotenone and were applied twice, on 18th June, about a fortnight after blossoming began, and 9 days later. Examination when picking began on 25th July showed that only about 1 per cent. of the berries contained larvae, irrespective of which spray was used. The berries on unsprayed bushes were heavily infested. In a subsidiary experiment, a single spray applied on 20th June gave almost as good control. The wide use of derris sprays by growers in 1935 confirmed their value.

SUIRE (J.). **Contribution à l'étude des coléophores, parasites des arbres fruitiers. I.** *Coleophora hemerobiella* **Scop.**—*Ann. Ec. Agric. Montpellier* **24** no. 2 pp. 137–158, 2 pls., 31 refs. Montpellier, August 1936.

Keys are given to the larvae of the species of *Coleophora* that attack fruit trees in the palaearctic region, based on the characters of their cases. The adult and larva of *C. hemerobiella*, Scop., are described, and its bionomics and distribution in France, where it has recently proved of some importance as an orchard pest, are discussed from observations of the author and others. The life-history in France is similar to that already recorded in the Ukraine [*cf. R.A.E.*, A **19** 500]. Towards the end of their development, the larvae were observed to attack pears of about an inch in diameter, causing them to drop. Parasites reared by the author were the Encyrtid, *Copidosoma coleophorae*, Mayr, from the eggs, and the Ichneumonid, *Omorgus borealis*, Zett., from larvae that had constructed their last cases. Exposed orchards are less infested, apparently because the newly hatched larvae drop from the leaves if they are shaken by the wind. Control measures are briefly discussed, and reference is made to dormant sprays found effective against a related species [**23** 174]. It is suggested that an arsenical spray in summer might be of value. Pruning eliminates all cases at the ends of branches.

FERRIÈRE (C.). **Un nouveau parasite de thrips de la Suisse.**—*Mitt. schweiz. ent. Ges.* **16** no. 9 pp. 637–639, 1 fig. Bern, 15th March 1936. [Recd. October 1936.]

KUTTER (H.). **Ueber einen neuen Endoparasiten** (*Thripoctenus*, **Chalcididae**) **des Erbsenblasenfusses** (*Kakothrips robustus* **Uzel**), **seine Lebensweise und Entwicklung.** [On a new Endoparasite of the Pea Thrips, *K. pisivorus*, Westw., its Life-history and Development].—*T.c.* pp. 640–652, 7 figs., 9 refs.

In the first paper, descriptions are given of both sexes of *Thripoctenus kutteri*, sp. n., reared from *Kakothrips pisivorus*, Westw. (*robustus*, Uz.) in Switzerland. The second paper includes information on the occurrence of this Eulophid, which is the one previously recorded as *Thripoctenus* sp. [*R.A.E.*, A **24** 291]. Eggs were seen from 25th June to 2nd July, larvae from 2nd to 8th July, pre-pupae from 9th to 10th July, and pupae only from 12th July onwards. Descriptions are given of pairing, oviposition, and all the immature stages and their development. In some localities *T. kutteri* parasitised 68 per cent. of the larvae of *K. pisivorus*, but as its activity ceases early in July, at least 33 per cent. of the progeny of a given female thrips escape parasitism.

NEUWEILER (E.). **Der Koloradokäfer. Seine Geschichte, Biologie und Bekämpfung.** [The Colorado Beetle. Its History, Biology and Control.]—*Landw. Jb. Schweiz* **50** no. 8 pp. 795–810, 3 figs., 18 refs. Bern, 1936.

This is the text of a lecture given in May 1936 and describing briefly the history, spread, biology and control of *Leptinotarsa decemlineata*, Say, in view of the prospect of its entry into Switzerland. A map showing its distribution in Europe up to July 1936 is included. The boundary of distribution in France is practically coincident with the Swiss frontier from Geneva to Delle.

WIESMANN (R.). **Untersuchungen über die Lebensgeschichte und Bekämpfung der Kirschfliege** *Rhagoletis cerasi* **Linné. III. Mitteilung.** [Investigations on the Life-history and Control of the Cherry Fly. Third Communication.]—*Landw. Jb. Schweiz* **50** no. 8 pp. 811–858, 2 figs., 25 refs. Bern, 1936. (With a Summary in French.)

A detailed account is given of work in 1934 on *Rhagoletis cerasi*, L., infesting cherries in Switzerland, carried out in continuation of previous investigations [*R.A.E.*, A **21** 681 ; **22** 433]. The flies were emerging from 15th May to 4th June, and the flight period lasted about 68 days. It was again observed that some pupae remain in the soil for two successive winters. About 80 pupae per sq. yd. occurred under badly harvested cherry trees and up to 60 per sq. yd. under late varieties of cherry even where harvesting was carried out carefully at the right date, showing that picking the fruit is insufficient for control and that the use of a soil insecticide to destroy the pupae is essential. This is all the more valuable as the alternation of the fly between cherry and *Lonicera* observed in Germany [**21** 375, etc.] is either slight or non-existent in Switzerland. Of 647 pupae collected, 12 per cent. were parasitised, chiefly by the Ichneumonid, *Phygadeuon* [illegible] *Colpognathus bremeri*, Hbm., and [illegible]ie adult parasites [illegible] the meadow land [illegible]ly of useful forms [illegible]t with 8 per cent. [illegible], ground treated in

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DI STEFANO (F.). **Sul numero delle generazioni e sul metodo di lotta della *Grapholitha leplastriana* Curtis.** [On the Number of Generations and on the Method of Control of *Cydia leplastriana*.]—*Bull. Ist. zool. Univ. Palermo* **2** no. 8–11 pp. 133–136, 3 refs. Palermo, July 1935. [Recd. November 1936.]

Observations on *Cydia* (*Grapholitha*) *leplastriana*, Curt., attacking cabbage and cauliflower, were made in Italy in 1933–34. It was found that 4 generations a year may occur in nature, though there were only 3 in captivity. The approximate periods from oviposition to adult emergence were 180, 75 and 70 days when the eggs were laid in October, late April and July, respectively. In experiments on cauliflowers, a nicotine dust gave the best control.

FLACHS (K.). **Krankheiten und Schädlinge an Oelpflanzen.** [Diseases and Pests of Oil-producing Plants.]—*Nachr. SchädlBekämpf.* **11** no. 3 pp. 130–148, 9 figs., 3 pp. refs. Leverkusen, August 1936. (With Summaries in English, French and Spanish.)

Since 1933 the area in Germany planted with rape has increased ninefold, and the cultivation of poppy and sunflower has also been considerably extended. For this reason, the author surveys from the literature the more important diseases and pests recorded as attacking these crops in Germany and neighbouring countries.

HILGENDORFF (G.). **Normen für Obstbaumkarbolineen und Baumspritzmittel (Teerölemulsionen).** [Standards for Fruit-tree Carbolineums and the Tar-oil Emulsions known as Baumspritzmittel.]—*NachrBl. dtsch. PflSchDienst* **16** no. 10 pp. 97–98. Berlin, October 1936.

An agreement has been reached between the German Imperial Biological Institute and the chemical industry for standardising the designations and composition of fruit-tree carbolineums and the tar-oil emulsions known as Baumspritzmittel [*cf. R.A.E.*, A **18** 183 ; **24** 797].

Fruit-tree carbolineums are divided into those from medium oil and from heavy oil, and these indications must be specified with the maker's name or trade name, no other terms being allowed. A fruit-teee carbolineum must be of uniform fluid consistency, without layers or precipitates. In 5 and 10 per cent. emulsions with distilled water it must not disintegrate when allowed to stand for 48 hours in full, sealed bottles. It must contain at least 75 per cent. of coal-tar oil of which not more than 70 per cent. must boil at 270°C. and not more than 10 per cent. at 200°C. The remaining portion if not also coal-tar oil of the specified character, must contain only substances known to be harmless. Fruit-tree carbolineum must not contain more than 10 per cent. of phenols, and at least 55 per cent. of the tar oils must be soluble in dimethyl sulphate. A product of which less than 25 per cent. of the oil boils at 270°C. is to be designated as fruit-tree carbolineum from heavy oil.

The Baumspritzmittel must be labelled as such, with the indication " tar-oil emulsion " and the maker's name or trade name. These preparations are defined as an aqueous emulsion of coal-tar oil of a consistency from that of cream to porridge. After agitation, the consistency must be uniformly fluid without any separated solid or oily portions. After standing for 48 hours, the 5 or 10 per cent.

aqueous spray emulsions may have thick or thin portions but no separated oil, and slight movement to and fro must readily restore the condition to that of a uniform liquid. Baumspritzmittel must contain at least 55 per cent. coal-tar oil, and not more than 40 per cent. of this oil should boil at 270°C. and not more than 10 per cent at 200°C. The remaining portion, if not also coal-tar oil of the specified character, must contain only substances known to be harmless. At least 55 per cent. of the tar oils must be soluble in dimethyl sulphate.

Sy (M.). **Zur Bekämpfung der Rhododendronwanze** *Stephanitis rhododendri* **Horv.** [Control of the Rhododendron Bug, *S. rhododendri*.]—*NachrBl. dtsch. PflSchDienst* **16** no. 10 pp. 98–99, 3 figs., 5 refs. Berlin, October 1936.

During the past three years, *Stephanitis rhododendri*, Horv., has caused considerable injury to rhododendrons in Berlin, where it was first recorded in 1928 [*R.A.E.*, A **17** 128]. By the end of June, the leaves on which the eggs had overwintered were completely yellow in consequence of damage by the nymphs, and a few spots were also noticeable on the current year's leaves, which were quite yellow a fortnight later. Tests with insecticides were made in the laboratory and in the open. Derris sprays proved the most effective ; a commercial brand used at the strength prescribed by the maker with the addition of 0·5 per cent. soap killed all the nymphs and adults in 2 days in the laboratory. Pyrethrum and nicotine required the addition of 2 per cent. soap to produce the same result. A 2 per cent. soap solution alone proved inadequate, and quassia only slightly enhanced the mortality produced by the soap added to it. In general, dusts of derris or pyrethrum were much inferior to sprays, and nicotine dust was useless. The insecticides were less effective out of doors, owing to the dense foliage, but it was found that a high percentage of mortality can be obtained by applying a derris spray containing at least 0·5 per cent. soap to the underside of the leaves. Complete control can be obtained by several applications, the first being made when the newly hatched nymphs are attacking the previous year's leaves. To reduce injury in spring, leaves bearing eggs could be plucked in autumn, but this should be unnecessary if spraying has been well done.

Lounsky (J.). **Evolution et possibilités de la désinsectisation des produits végétaux par fumigation.**—*Bull. Inst. agron. Gembloux* **5** no. 2 pp. 153–159. Gembloux, May 1936. (With Summaries in Dutch, German and English.)

Recent work on fumigants for the control of insects infesting stored products and plant material is reviewed from the literature.

Plantesygdomme i Danmark 1935. [Plant Diseases and Pests in Denmark in 1935.]—*Tidsskr. Planteavl* **41** pp. 533–570, 4 figs. Copenhagen, 1936. (With a Summary in English.)

This report includes (pp. 537–549) a list of the diseases and pests of cultivated plants observed in Denmark in 1935, together with notes by P. Bovien (pp. 562–566) on the more interesting pests, some of which were noticed in previous reports [*R.A.E.* A **24** 55 ; **22** 668, etc.]. The others are *Barypithes pellucidus*, Boh., on cabbage, *Cneorrhinus plagiatus*, Schall., on swedes, *Athalia rosae*, L. (*spinarum*, F.)

on turnips and radishes, *Dolerus gonager*, F., the adults of which are stated to have gnawed the buds and leaves of young fruit trees, *Barathra* (*Mamestra*) *brassicae*, L., on swedes and beet, and *Monarthropalpus buxi*, Lab., on box [*Buxus*]. In localities where *Paratetranychus pilosus*, C. & F., was very abundant on apple, cocoons of the Coniopterygid, *Conwentzia psociformis*, Curt., were found in large numbers on the trunks, branches and fruit.

HUKKINEN (Y.), LISTO (J.) & VAPPULA (N. A.). **Kertomus tuhoeläinten esiintymisestä Suomessa vuosina 1926 ja 1927.** [Report on the Occurrence of Pests in Finland in 1926 and 1927.]—*Valt. Maatalousk. Julk.* no. 82, 107 pp., 6 maps, 2 pp. refs. Helsinki, 1936. (With a Summary in German.)

Most of the pests recorded here were mentioned in previous reports [*R.A.E.*, A **23** 516, 517]. Others that caused serious injury were *Argyresthia ephippella*, F. (*pruniella*, auct.), attacking the buds and leaves of cherry, *Tortrix* (*Cacoecia*) *rosana*, L., on currants and gooseberries, and *Eriophyes ribis*, Nal., on black currant [**23** 755].

[BILANOVS'KIĬ (I. D.).] **Биланoвський (І. Д.). Notizen über die Biologie und wirtschaftliche Bedeutung einiger Zweiflügler.** [Notes on the Biology and economic Importance of some Diptera (I).] [*In Ukrainian.*]—*Trav. Mus. zool. Acad. Sci. Ukr.* no. 17 pp. 59–61, 6 refs. Kiev, 1936. (With Summaries in Russian and German.)

Brief records are given of observations in the Kiev district on the Tachinid, *Melanophora roralis*, L., the Sarcophagid, *Agria mamillata*, Pand., and the Phorid, *Megaselia* (*Aphiochaeta*) *rufipes*, Mg. The larvae of *Melanophora* occurred in damp dust that accumulated in chinks between the glass and the wood in old window frames, where they fed on the larvae and pupae of Sciarids. It apparently has two generations a year, as the adults were observed in June and again at the end of August and in September. The larvae of *A. mamillata* were observed in nests of *Hyponomeuta padellus malinellus*, Zell., which were very abundant on apple early in the summer of 1934. They attacked the cocoons, and destroyed so many that the infestation was considerably reduced. They pupated in June, but in spite of a very favourable summer, the adults did not emerge until the spring of 1935. *Megaselia rufipes* infested germinating seeds of wheat kept between damp filter paper in the laboratory in August. The infested seeds were often attacked by several larvae and completely hollowed out. Pupation occurred on 6th September and the adults emerged 23 days later. This Phorid was very abundant in the field during the wet years of 1933 and 1934, and may have been responsible for a marked reduction in germination of autumn-sown cereals that occurred in those years.

[PARAMONOV (A. Ya.). **Парамонов (А. Я.). Zur Biologie des Blausiebs** (*Zeuzera pyrina* **L.**). [Contribution to the Biology of the Leopard Moth, *Z. pyrina*.] [*In Ukrainian.*]—*Trav. Mus. zool. Acad. Sci. Ukr.* no. 17 pp. 79–101, 2 refs. Kiev, 1936. (With Summaries in Russian and German.)

An account is given of investigations carried out in the Ukraine in August 1930 and June–July 1932 on the damage caused by the Cossid, *Zeuzera pyrina*, L., to deciduous forest trees [*cf. R.A.E.*, A **17** 148].

Ash was chiefly attacked, being followed in descending order of preference by oak, elm and maple. Infestation was most severe in stands of trees that were 25–30 years old and were growing under bad conditions, and was more widely distributed in artificial plantations than in natural stands. Of the infested trees, 84 per cent. were attacked on the side of the trunk exposed to the sun. The galleries were most numerous at the base of the trunk and did not occur higher than 7 ft. from the ground. The importance of the injury was found to depend on the number and position of the galleries and the age and condition of the tree. Infestation by 1–2 larvae reduced by about 25 per cent. the normal increase in height of ash trees that were 2 or 3 years old. Only the apparently healthy parts of the trees were attacked. In the Ukraine, the life-cycle of *Z. pyrina* is completed in 2 years, and in the forests examined the adults are on the wing every other year. This regularity in years of flight is probably due to the infestation having originated from larvae that were infesting the seedlings used for the afforestation of the steppe and were all of the same year, and to the isolated position of the forests having prevented fresh infestation by adult moths of a different strain.

Improved silviculture is the only reliable method of safeguarding forests from the infestation. Ash should not be included in stands planted on steep hills with a poor and dry soil, and the undergrowth should not be removed from plots exposed to the sun, as it keeps the trunks shaded, and so reduces infestation. Nurseries should be isolated from forests, and infested seedlings should be removed from them. Infested trees in the forest should be felled in the spring of the year of the flight, or in the preceding autumn, as it is then easier to detect the infestation. The felled timber should be removed, as observations showed that larvae that are two years old usually complete development in it, though younger ones apparently do not survive. Destruction of the larvae by pushing thin twigs into their galleries would be most effective if carried out just before they pupated.

Hydrogen Sulphide and its Application in controlling the Pests and Diseases of Crop Plants. [*In Russian.*]—*Bull. Plant Prot.* (3, Contr. Meas. Implem.) no. 6, 99 pp., many refs. Leningrad, 1935. Price 3 *rub.* (With Summaries in English.) [Recd. 1936.]

This is a report of a conference held in March 1935 in Rostov-on-Don on the use of hydrogen sulphide (H_2S) for the control of pests of plants and stored products, particularly fungi and bacteria, together with the texts of papers read. In Hydrogen Sulphide as a Means of Plant Protection, by N. N. Arkhangel'skiĭ (pp. 9–47), the properties of H_2S are discussed and an account is given of experiments with it against various pests, including insects and mites. The gas was obtained from sodium sulphide by pouring dilute hydrochloric acid over it, from dust made by grinding sulphurous slag containing 20–40 per cent. aluminium sulphide, which gave off the gas on contact with air, or from liquefied hydrogen sulphide, the production of which is described.

It was found that most insect pests of stored products were killed by 4–6 per cent. concentrations of H_2S after an exposure of 12–24 hours. The granary weevil [*Calandra granaria*, L.] proved the most resistant, complete mortality in 24 hours requiring a concentration of 8 per cent. in an empty room, or 18–23 per cent. in a granary filled with grain.

In experiments in North Caucasus, 100 per cent. mortality of *Aonidiella* (*Aspidiotus*) *perniciosa*, Comst., on nursery stock was obtained in 30–60 minutes with 6–8 per cent. H_2S, and the plants were not affected. Dense growths of willows severely infested with leaf-eating larvae were treated with the sulphurous slag at the rate of 1·8 oz. per sq. yd.; within a few minutes all the larvae dropped to the ground, where most of them were killed by the gas concentrated in the dense grass.

In laboratory experiments with grain mites isolated from the grain, a 6 per cent. concentration of H_2S gave complete mortality in 2 hours. In the presence of the grain, however, owing to its power of absorption, the gas concentration had to be increased by 60–100 per cent. in the case of wheat and by 200–300 per cent. in the case of barley. The gas was effectively introduced into large masses of grain through a long iron pipe having slits at intervals of about 20 ins. for its escape. With an exposure of 48 hours, 2–3 oz. H_2S to 10 cu. ft. of grain was sufficient to kill all the mites if the grain was loose. When it was contained in sacks stacked in a hollow square under a tarpaulin, the dosage had to be increased to 3–4 oz. The effectiveness of hydrogen sulphide under winter conditions was shown by experiments in which grain in sacks was fumigated at the rate of 3·5–5 oz. to 10 cu. ft. of grain, when the air temperature varied from −20 to −30°C. [−4 to −22°F.] and that of the grain from 1 to −4°C. [33·8 to 24·8°F.], complete mortality of the mites and their eggs being obtained in 20 hours. The sulphurous slag also proved effective in the laboratory, and it was then used in large scale tests by placing it in bags among sacks of grain stored under tarpaulins. When applied in this way at the rate of 4–4½ lb. per ton of grain, it had killed all the mites and their eggs by the fifth day.

It was found dangerous to feed domestic animals on fumigated forage unless it had been well aired. Investigations on the baking qualities of flour made from fumigated grain showed that the hydrogen sulphide contained in it is dispersed when hot water is added to the flour and while the warm dough rises. The development of the yeast, however, is retarded, and dough made of unaired flour rises slowly. Hydrogen sulphide was present for 30 days in flour made from treated grain, but bread baked from it 10 days after the grain had been fumigated did not differ from the control.

The tests described in Hydrogen Sulphide in fumigating Plants and Seeds, by P. I. Kiyashko (pp. 52–56), include some in which it was used in Transcaucasia for fumigating potted plants of various species infested with *Pseudococcus gahani*, Green. The dosages varied from 2 to 50 oz. per 100 cu. ft. and the exposures from 1 to 24 hours. In most cases when a high rate of mortality of the Coccid was obtained, the plants were severely injured, though the degree of injury varied with the species of plant. Hydrogen sulphide might, however, be used for fumigating plants against pests that are susceptible to lower concentrations of the gas. In experiments by Goritzkaya, 74–97 per cent. mortality of *Tetranychus* on cotton was obtained with 0·6 oz. per 100 cu. ft. in 2 hours, and the foliage was not injured.

In the Effect of Hydrogen Sulphide on Seeds, by N. M. Edel'man (pp. 65–67), a brief account is given of experiments in which seeds of 39 kinds of field crops and vegetables were fumigated with 20–50 oz. H_2S per 100 cu. ft. for 24–28 hours. The germination of most of the seeds was not affected; that of tomato seeds, which proved the most susceptible, was only reduced by 2–6 per cent.

Les coccinelles du melon (*Epilachna chrysomelina* **F. et** *Epilachna argus* **Geoff.).**—*Memento Déf. Vég.* [*Dir. gén. Agric. Maroc*] no. 36 5 pp., 1 pl. Rabat, August 1936.

A brief account is given of the bionomics and control of *Epilachna chrysomelina*, F., attacking melons and other cucurbits in Morocco [*cf. R.A.E.*, A **24** 680]. *E. argus*, Geoffr., has similar habits and causes the same type of injury, but appears to be less widespread. Control measures include the use of a dust containing 50 per cent. sodium fluosilicate, 5 per cent. nicotine sulphate and 45 per cent. gypsum, which has given good results.

Séguy (E.). **L'***Acemyia calloti*, **insecte diptère à larves endoparasites des sauterelles.**—*Ann. Paras. hum. comp.* **14** no. 4 pp. 321–326, 2 figs., 7 refs. Paris, 1936.

This paper comprises a brief discussion of the species of the Tachinid genus *Acemya*, with descriptions of both sexes of the type, *A. acuticornis*, Mg., and of a new species, *A. calloti*. The latter has been reared from *Anacridium* (*Acridium*) *aegyptium*, L., in Tunisia [see next paper] and from *Stenobothrus* sp. in the south of France.

Callot (J.). **Note sur des** *Acemyia*, **mouches parasites à l'état larvaire d'***Acridium aegyptium* **et sur un champignon hyperparasite.**—*Ann. Paras. hum. comp.* **14** no. 4 pp. 327–329, 2 refs. Paris, 1936.

Ten larvae of *Acemya* emerged on 5th June from a single male of *Anacridium* (*Acridium*) *aegyptium*, L., collected in Tunisia. The grasshopper died 2 days later. The larvae pupated immediately, and the pupae were kept in a moist atmosphere at a mean temperature of 25°C. [77°F.]. Eight adults emerged on 20th June; seven of these were *Acemya acuticornis*, Mg., and the other *A. calloti*, Séguy [see preceding paper]. The two remaining pupae died, one being attacked by *Beauveria globulifera*.

Bredo (H. J.). **Sommaire des observations faites au Congo belge et projet des futures recherches sur les acridiens migrateurs.**—*Bull. agric. Congo belge* **27** no. 2 pp. 298–302. Brussels, 1936.

An outline is given of the organisation for reporting locust activities in the Belgian Congo, and of the field research work carried out in the north-east of the Colony.

Numerous swarms of *Locusta migratoria migratorioides*, R. & F., were present throughout the north and north-east in 1932–33, egg-laying being concentrated in the lowlands round Lake Albert, where the swarms persisted until the beginning of 1935, after their disappearance from the neighbouring areas. Here, numerous individuals of phase *solitaria*, mixed with phases *gregaria* and *transiens* and apparently the progeny of the invading swarms, were first observed in January 1935. The climate and vegetation of the Lake Albert lowlands are briefly discussed; since the population of phase *solitaria* has been steadily declining, it is concluded that the conditions there are unsuitable for the permanent establishment of this species. The invasion of the north-east of the Belgian Congo by *Nomadacris septemfasciata*, Serv., did not extend to the north of 1°S. lat., but persisted till 1935.

Isolated individuals were, however, found further north, in the Ituri highlands and Lake Albert lowlands. The rise of soil temperature by 18·7°C. [33·66°F.], produced by the burning of grasses did not injure the eggs of *Locusta*. *Stomatorrhina lunata*, F., parasitised the egg-pods of both species, and the hoppers and adults were preyed upon by birds (*Bulbulcus ibis* and *Sphenorhynchus abdimii*).

Observations were made on *Homorocoryphus vicinus*, Wlk., which swarms annually at the beginning of the dry season in the Lake Albert and Lake Edward lowlands. A swarm of this Tettigoniid was carried by wind from an altitude of 3,000 ft. to the crater of Naimlagira, about 10,000 feet high.

STEYAERT (R. L.). **Un ennemi naturel du** *Stephanoderes*, **le** *Beauveria bassiana* **(Bals.) Vuill. Étude des facteurs ambiants régissant sa pullulation.**—*Publ. Inst. Étude agron. Congo belge* Sér. sci. no. 2, 46 pp., 9 figs. 28 refs. Brussels, 1935. Price *Fr.* 5. [Recd. October 1936.]

Beauveria bassiana was found infesting *Stephanoderes hampei*, Ferr., in the Belgian Congo in 1933, and investigations, here described in detail, were therefore undertaken to determine the influences of environmental factors on it. To ascertain the seasonal occurrence of infestation, samples of green and ripe coffee berries were collected monthly from June 1933 to June 1934 from a large plantation and examined ; the results are given in a series of tables. The percentage of dead beetles was greatest (about 63) in July and August ; the beetles were most abundant in January and February and least in September ; and the numbers of beetles killed by the fungus were largest in July, October and June (1934), and smallest in March and April. The period of maximum abundance of the beetle corresponded to the time when the green berries were least numerous, and the numbers of perforated berries were inversely proportional to those of the green berries. The insect population increased considerably when the berries were ripening, that for December being four times that for November, although 36 days are needed to complete the life-cycle. Ripe berries are available in October, and it is thought that the population failed to increase then on account of the abundance of the fungus.

The highest mortality percentages on any one plot over the whole period of the investigation were 48·2 and 3·28 for beetles infesting green and red berries respectively, while in any one month the highest percentage for those on green and red berries on all the plots was 63·9 and 28·69. The fact that insects in the green berries were more susceptible to infestation suggested the influence of humidity, but there did not appear to be any correlation between rainfall and infestation although there was a negative correlation between insolation and the rate of mortality. The beetles in the two most shaded plots were also the most heavily infested, showing mortality rates of 8·2 and 13·61 per cent., while in two others in much more exposed positions the rates were 1·83 and 3·09 per cent.

Laboratory experiments to determine the exact effects of humidity were carried out. Sets of tubes filled with red, green and black berries, which had been sterilised and then placed with the beetles until many had entered them, were contaminated with conidia of *Beauveria* from a culture isolated from *Stephanoderes* about a month previously. Some of the berries were examined every three days to determine the

condition of the beetles, and those showing fruiting bodies of the fungus were considered to have been killed by it, those with mycelium only were doubtful cases, and those with no traces of the fungus were said to have died naturally. The percentages of beetles killed by the fungus on green, red and black berries at different relative humidities were 26·31, 7·51, and 3·76 at 0 per cent.; 17·31, 11·64 and 4·12 at 58 per cent.; 17·86, 21·95 and 11·49 at 79·5 per cent.; and 32·8, 30·77 and 8·98 at 98 per cent.

In a second set of experiments green berries only were used. They were inoculated before the beetles were introduced into the tubes, and some were examined every two days. The differences between the mortality of beetles in control tubes and in those treated with the fungus at humidities of 0, 58, 79·5 and 98 per cent. were 17·0, 4·18, 3·49 and 13·06 per cent., the actual mortality rates for the beetles on the inoculated berries at these humidities being 71·98, 71·64, 68·19 and 50·99 per cent.

The author concludes that infestation by the fungus takes place as a rule on the surface of the berry and is most likely to occur when the beetles are flying from one to another to deposit their eggs. Cloudy weather is also a predisposing cause, as the beetles are more active then than in bright sunlight. Humidities above 79 per cent. do not appear to increase infestation. For use in a spray or dust, the conidia of the fungus should be finely ground; applications should be made when there are few ripe berries and during months when there is little sunshine.

JOHNSTON (W. C.). **Widespread Aphid Attack on Artichokes.**—*J. Dep. Agric. S. Aust.* **40** no. 1 p. 41. Adelaide, August 1936.

This paper records a severe infestation by *Capitophorus* sp. of wild artichoke (*Cynara cardunculus*), which is widely distributed throughout the northern areas of South Australia. The attack began in the spring of 1935, and its intensity greatly increased in 1936.

EVANS (J. W.). **The Potato Moth.**—*Tasm. J. Agric.* **7** no. 3 p. 119, 3 refs. Hobart, 1st August 1936.

This is a very brief note on the bionomics and control of *Phthorimaea operculella*, Zell., which is considered the most important insect pest of potatoes in Tasmania.

GURNEY (W. B.). **Parasites of White Wax Scales collected in East Africa.**—*Agric. Gaz. N.S.W.* **47** pt. 8 pp. 453–456, 464, 472, 7 figs. Sydney, August 1936.

A brief account is given of a search in India, Kenya and Uganda for parasites of *Ceroplastes* spp. for introduction into New South Wales against *C. destructor*, Newst., infesting *Citrus* and other plants [*cf. R.A.E.*, A **22** 312, etc.]. No parasites were found in India, but several consignments of parasitised material were sent from Kenya and Uganda by air-mail (*via* Alexandria) and 25 species of parasites, alive or dead, were obtained from them at Sydney. Only three could be reared, however, and two of these, *Diversinervus elegans*, Silv., from Kenya and an Encyrtid from Uganda, only completed a single generation, the offspring being all of one sex. The third, *Scutellista cyanea*,

Motsch., from Kenya, was successfully reared on *C. destructor* and *Saissetia oleae*, Bern., and about a hundred individuals were released. It is of interest that *S. cyanea* is known to occur in New South Wales as a parasite of *S. oleae*, but has never been recorded there from *Ceroplastes*, so that the Kenya race may be biologically distinct. It is hoped to obtain further consignments of the other parasites from East Africa.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **47** pt. 8 pp. 457–461, 8 figs., 1 ref. Sydney, August 1936.

This paper is one of a series on insect pests in New South Wales [*cf. R.A.E.*, A **24** 806]. Those dealt with include *Dermestes vulpinus*, F., the larvae of which sometimes cause serious damage to stored hides [*cf.* **22** 617]. The egg, larval and pupal stages last 3–7, 44–60 and 7–10 days, respectively, and the adults may live for 4 months. Hides may be protected from infestation by painting them with a solution of 1 lb. sodium arsenite in 12 gals. water or by storing them at a temperature of 40°F. or lower. Infestation can be eliminated by exposure to 125–140°F. for an hour, or by fumigation with carbon bisulphide or hydrocyanic acid gas.

Canada : The Destructive Insect and Pest Act and Regulations thereunder. Acts, Orders and Regulations, no. 8.—3rd revd edn, 36 pp. Ottawa, 1936.

This revised edition again brings up to date the Regulations under the Destructive Insect and Pest Act [*cf. R.A.E.*, A **16** 572], and includes a new regulation (no. 22 Foreign), which became effective on 10th June 1936, to prevent the introduction of virus and other diseases of lilies into Canada. The import of dormant bulbs of the genus *Lilium* is prohibited from the Empire and Dependencies of Japan, unless accompanied by a certificate stating that they were apparently free from any insect, pest, or disease immediately before packing, and had been grown under certain specified conditions.

Finlayson (L. R.) & Reeks (W. A.). **Notes on the Introduction of *Diprion* Parasites to Canada.**—*Canad. Ent.* **68** no. 7 pp. 160–166. Orillia, 1936.

A brief account is given of the collection of cocoons and eggs of *Diprion* spp. in Europe in 1932–35 and their transport to Canada with a view to using their parasites against the introduced spruce sawfly, *Diprion polytomus*, Htg. The total number of cocoons received in Canada were 37,915 of *D. polytomus*, from Germany and Czechoslovakia, 6,119,766 of *D. sertifer*, Geoff., from Austria, Hungary, Czechoslovakia and Sweden [*cf. R.A.E.*, A **23** 747], a mixed collection of 1,550 of *D. virens*, Klug, *D. frutetorum*, F., and *D. sertifer*, 851 of *D. virens* and 492 of *D. frutetorum*, from Czechoslovakia and 831 of *D. pini*, L., from Germany. In 1935, 390,000 eggs of *D. sertifer* were imported from Czechoslovakia and Sweden. In addition, 26 Tachinid puparia were received from Europe, 14,032 cocoons of *D. similis*, Htg., from Ontario and 148 cocoons of *Lygaeonematus erichsoni*, Htg., from British Columbia. European material was carried by air to England and there repacked and shipped to Canada in the cold storage rooms of the vessels. It reached Ontario about 12 days after leaving Central Europe.

At first, the parasites from the material were reared in small vials plugged with cotton wool, a method that reduced the danger from hyperparasitism and allowed accurate records, but, as the work progressed, rearing in bulk was also carried out under specific quarantine conditions in large cages (10 by 7 by 6½ ft. high), in which the cocoons were placed on trays. The emerging parasites were collected into glass-topped boxes or small movable cages. Egg-parasites were reared on moistened blotting paper in well-fitting petri dishes. Parasites were packed in screen-sided metal containers cooled by ice, with a removable rack provided with moistened cotton or with moistened excelsior. The smaller parasites were usually transported in corked glass vials. Laboratory propagation was not attempted with most of the parasites because of the quarantine conditions necessary, but it was carried out with the Eulophid, *Microplectron fuscipenne*, Zett. [*cf. loc. cit.*], as it could be reared on the dead host. The method adopted was to introduce a paired female with two cocoons, the larvae in which had been killed by immersion in water at 140°F., into a small shell vial. The vials are plugged with cotton wool and then placed in an incubator at 80°F. In 12 days the parasites have pupated, and most of the cocoons are placed in cold storage. The adult parasites emerge from the remaining cocoons in 3 days, and from these are bred the next generation. The cocoons from storage are transported to the field in small flat cages with screen sides, the mesh of which is strong enough to protect them from rodents and large enough to allow the parasites to escape. The cocoons are placed against the screen on both sides with a layer of moss in the middle, and the parasites emerge in a few days. In 1934, over 2½ million individuals of *M. fuscipenne* and over 1,000 of *Coelopisthia nematicida*, Pack., a native parasite, were reared by this technique. The approximate numbers of parasites released were 14,900 in 1933, 958,900 in 1934, and 2,515,500 in 1935. The species released against *D. polytomus* were *Microcryptus basizonus*, Grav., *Monodontomerus dentipes*, Boh., *Eutelus subfumatus*, Ratz., *Microplectron fuscipenne*, and *Coelopisthia nematicida*, which attack the cocoons, *Mesoleius multicolor*, Grav., *Torocampus eques*, Htg., *Exenterus* spp., *Holocremnus ratzeburgi*, Tschek, *Lophyroplectus luteator*, Thnb., and *Sturmia inconspicua*, Mg., which attack the larvae, and the egg parasites, *Achrysocharella ruforum*, Krausse, and *Tetracampe diprioni*, Ferrière. These liberations, which were made in Quebec, both north and south of the St. Lawrence River, and at two points in New Brunswick, included 2,238,000 of *M. fuscipenne*, 186,600 of *Exenterus* spp. and 11,900 of *L. luteator*. In 1935, small numbers of *Exenterus* and *Microcryptus* and several thousand *Microplectron* were liberated against *D. frutetorum* and about 2,400 *Monodontomerus* against *D. similis* at Montreal. Most of the imported cocoons are still in storage, as after two seasons' emergence some of the parasites are not yet fully developed.

As *D. polytomus* remains 1–5 years in diapause, it was desirable to obtain samples of the cocoons of the current year's origin for recovering parasites in addition to taking samples from the moss. Sixth-instar larvae were therefore collected daily from selected areas under infested trees and placed in containers for spinning. Three of the parasites, *Microplectron fuscipenne*, *Microcryptus basizonus* and *Exenterus marginatorius*, F., have already been recovered. Under laboratory conditions, *M. fuscipenne* has been reared on *D. sertifer*, *D. frutetorum* and *D. similis* and multiplies readily on *D. polytomus*, one female laying up to 215

eggs. It was found that some of the eggs may be ingested by the host larva, but though up to 90 were destroyed in this way, if they were artificially placed in the cocoon, few are lost normally as the host appears to be partly paralysed. Hibernation of reared parasites occurs in the late larval, prepupal and pupal stages, and adults begin to emerge about 20th June. The life-cycle occupies about a month. The progeny of unmated females are males, and of mated ones females with a small number of males. *Microcryptus basizonus* readily attacks *D. polytomus* and searches more thoroughly for the cocoons than *Microplectron*. The eggs were laid singly in the cocoons and hatched in about 4 days. The larval period occupied 12–13 days, and 3 successive generations were reared during the summer, but some of the pupae of the first and second generations remained in diapause until the following season. Hibernation took place in the pupal and possibly the late larval stages, and the adults of the reared material started to emerge in mid-June. *Exenterus marginatorius*, F., also attacked *D. polytomus* readily and began to emerge in late June. Seven adults in captivity deposited an average of 67 eggs externally on larvae of the fifth instar. Third and fourth instar larvae were also attacked, but the parasite eggs hatched prematurely, and the young larvae did not survive. Normally, the egg hatches in the host cocoon. Occasionally a larva is parasitised several times, but only one parasite reaches maturity on each host. The life-cycle occupies 4–5 weeks, and one generation and part of a second occurred during the year. Unpaired females produced male progeny.

GAHAN (A. B.). **Four new Species of Chalcidoidea parasitic on Cactus Insects.**—*Proc. U.S. Nat. Mus.* **83** no. 2995 pp. 481–486, 1 ref. Washington, D.C., 1936.

Descriptions are given of four new species of parasitic Chalcidoids reared from cactus insects by representatives of the Australian Prickly Pear Board in 1928–29, *viz.*, *Callimone bifasciipennis* from *Phytophaga* sp. infesting *Opuntia* in Mexico, and *Rileya opuntiae* from *Asphondylia opuntiae*, Felt, *Tetrastichus gerstaeckeriae* from *Gerstaeckeria porosa*, Lec., and *Neocatolaccus moneilemae* from cocoons of *Moneilema ulkei*, Horn, all in Texas.

GLASGOW (H.). **Calomel : A promising Insecticide for Root Maggot Control.**—*Farm Research* **2** no. 3 pp. 3, 7, 13, 3 figs. [Geneva, N.Y.] 1936. (Abstr. in *Exp. Sta. Rec.* **75** no. 2 p. 228. Washington, D.C., 1936).

Though it is no more effective than corrosive sublimate [mercury bichloride] in the control of the root maggot [*Phorbia brassicae*, Bch.] on cabbage, calomel [mercurous chloride] has a number of advantages. As it is practically insoluble, it can be used in more concentrated doses without danger of injury, so that satisfactory control can often be obtained with one or at most two applications of a suspension of 3–4 oz. in 10 U.S. gals. water. Furthermore, it does not delay the date of harvesting, as corrosive sublimate appears to do. It may be used as a dust [*cf. R.A.E.*, A **23** 654], mixed with about 95 per cent. gypsum or hydrated lime to facilitate application, or for seed treatment, which is not quite so effective in control but requires less time and labour. The seeds should be moistened with a fairly concentrated solution of

cheap gum, using approximately 1 oz. solution per lb. seed, and should then be treated with an excess of dry calomel until 1 lb. seed retains 1·5–2 lb. calomel, the individual seeds being uniformly coated with a heavy deposit of the powder.

Dean (G. A.), Cotton (R. T.) & Wagner (G. B.). **Flour-mill Insects and their Control.**—*Circ. U.S. Dep. Agric.* no. 390, 33 pp., 24 figs., 4 refs. Washington, D.C., July 1936.

The losses caused by insects to stored grain and milled products in the United States amount to about 5 per cent. of the total value of the products, or about £50,000,000 annually, and this does not take into consideration the injury to the reputation of well established brands of goods when they are damaged by insects. This circular includes notes on the more important pests of flour mills and the main sources of infestation, and an account of methods of effecting control applicable to infestations on the farm, and in grain elevators, flour mills and warehouses. The chief methods are sanitation, fumigation and treatment by heat ; mill fumigation with hydrocyanic acid gas [*cf. R.A.E.*, A **24** 719] is dealt with in some detail.

Houser (J. S.). **The Black Wheat-stem Sawfly.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* **21** no. 182 pp. 109–111, 2 figs. Wooster, Ohio, 1936.

A survey in 1936 showed that infestation of wheat by the black wheat-stem sawfly [*Trachelus tabidus*, F.] in Ohio has spread towards the west and the south-east, and has increased considerably in the areas where the damage was greatest during the two previous seasons [*cf. R.A.E.*, A **24** 297]. In two counties infestation reached 68 per cent., and further observations confirmed the advisability of early harvesting.

Neiswander (C. R.). **The White Mold Mite on Tomato.** *Eriophyes cladophthirus* **Nalepa.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* **21** no. 182 pp. 114–116, 2 figs. Wooster, Ohio, 1936.

In and after the autumn of 1933, *Eriophyes cladophthirus*, Nal., was found infesting tomatos in greenhouses in the north of Ohio. Only in one case (in December 1934) was the damage severe, when it was estimated at 30 per cent. of the crop, and practically every plant in the 2½ acres of house was infested. A smaller but still significant amount of damage occurred during the winter of 1935–36 in another house. The mite, which is briefly described, does not appear to kill the plants, but increases rapidly in abundance as they mature, and stimulates the development of a hair-like growth. The only other records of its occurrence in the United States are on tomatos in the field in Florida. Although the source of infestation in Ohio is not known, it may possibly be bittersweet (*Solanum dulcamara*), on which the mite is found in Europe, and which is distributed over the north of Ohio. In January 1935, an infested greenhouse was fumigated by burning sulphur at the rate of ½ lb. per 1,000 cu. ft. space, and the treatment was repeated the next day. The plants were then removed, and a new crop started ; within 2–3 weeks of planting only 22 plants in 2½ acres were infested.

When these were removed, no new injury appeared, and no new infestation has occurred on subsequent crops. This measure also proved effective in another greenhouse. In the two cases in which it was tried, the sulphur appeared to be more completely burned when placed with a shovelful of coals in a container made by cutting off an oil drum 10 ins. from the base.

VAN DYKE (E. C.). **A Cactus Destroyer.**—*Pan-Pacif. Ent.* **12** no. 3 p. 103. San Francisco, Calif., 1936.

The Tineid, *Dyotopasta yumaella*, Kearfott, was found to be killing many clumps of a small species of cactus with few spines (probably *Opuntia basilaris*) in southern California. During April 1936, the main stems of many of the plants were honeycombed by the numerous larvae, which reduced the tissues to a liquid and putrid condition.

LIGHT (S. F.). **A tropical Termite in California.**—*Pan-Pacif. Ent.* **12** no. 3 pp. 125–126. San Francisco, Calif., 1936.

A young colony of *Calotermes brevis*, Wlk., consisting of the royal pair and about a dozen nymphs, was found in California in a small piece of wood forming part of a letter file that had been brought from Peru 6 weeks previously. This termite is widely distributed throughout the West Indies, Mexico and Central America, and also occurs as far south as British Guiana on the north-east coast of South America, but has not before been found on the west coast. There is, however, reason to believe that it is well established in Lima, causing considerable damage, but it is unlikely that it would become established in California, owing to unsuitable climatic conditions for swarming and the establishment of new colonies. It lives in dry wood without connection with the ground, and chiefly attacks manufactured wood and other materials that contain cellulose. Its ability to live in thin pieces of hard wood increases the range of its destructiveness and the risk of its distribution. The author believes that *Calotermes* (*Cryptotermes*) *pseudobrevis*, Fuller, described from South Africa [*R.A.E.*, A **9** 580] is almost certainly a synonym of *C. brevis*, and that a more complete knowledge of its range of variation may show that *C.* (*Cr.*) *piceatus*, Snyder, from Hawaii [**10** 458], the Marquesas and Hongkong, and *C.* (*Cr.*) *darwini*, Light, from the Galapagos Islands, may also be conspecific with it.

JAYNES (H. A.) & BYNUM (E. K.). **A preliminary Report on the Use of the Egg Parasite *Trichogramma minutum* Riley for the Control of the Sugarcane Borer.**—*Sug. Bull.* **14** no. 19 pp. 1–4. New Orleans, La, 1st July 1936.

Experiments to estimate the value of releasing *Trichogramma minutum*, Riley, for the control of *Diatraea saccharalis*, F., on sugarcane in Louisiana [*cf. R.A.E.*, A **22** 578, etc.] were carried out from 1933 to 1935, inclusive, on a series of plots in three heavily infested districts. The sizes of the plots varied from $2\frac{3}{4}$ to 26 acres in 1933 and from 1 to $8\frac{3}{4}$ acres in the subsequent years. State recommendations for the numbers of parasites to be released are 5,000 per acre in June, or 10,000 if the release is delayed till later. In 1933, 1934 and 1935, the numbers released were as much as 12,000, 18,500 and 45,000 per

acre, respectively. Most of the releases were made in June on dates selected from observations of oviposition by the moth. Each year examinations for egg clusters were started in April and continued at intervals of 2 or 3 weeks until about the end of September. Throughout the three seasons very little difference in parasitism was observed between the plots where the parasites had been released (A), those used as buffers (B), and the controls (C). Estimates of infestation made by the examination of stalks during the harvest season of each year also showed that no difference existed between the plots. Comparison of the yield of sugar showed that in 1933 the C series surpassed the A series by an average of 8·5 lb. per ton of cane, and 293 lb. per acre, while the B series gave less per ton of cane but more per acre than either of the others. These three series maintained the same relationship to each other, with a slight variation in yield, for the two following years. In some of the experiments, the difference in yield between the cuts on an A plot was greater than that between the A and C plots of the same experiment. The authors conclude that release of *Trichogramma* is of no value for the control of *Diatraea* in Louisiana.

Pickles (A.). **Report of the Entomologist for the Year 1935.**—*Rep. Dep. Agric. Trin. Tob. 1935* pp. 50–51. Trinidad, 1936.

Brief notes are given on work in progress on insect pests in Trinidad in 1935, mainly carried out before the appointment of the author as entomologist to the Department of Agriculture in November. *Zenillia palpalis*, Aldr., was introduced from British Guiana for the control of *Castnia licoides*, Boisd. (*licus*, auct.) on sugar-cane [*cf. R.A.E.*, A **24** 278], but does not appear to have become established. Work on the breeding and liberation of *Dasyscapus parvipennis*, Gah., a parasite introduced against *Selenothrips rubrocinctus*, Giard, on cacao is being continued [*cf.* **24** 304]. Injury to fruits of orange and grapefruit popularly attributed to *Anastrepha* was found to be primarily due to a Lepidopterous larva. No example of *Anastrepha* was found in over 2,000 fruits examined. The chief pests of stored products are *Ephestia* sp. in cacao, *Calandra oryzae*, L., in maize, and *Bruchus* (*Pachymerus*) *quadrimaculatus*, F., in cowpeas.

Bruner (S. C.) & Scaramuzza (L. C.). **Reseña de los insectos del tabaco en Cuba.** [A Review of the Insect Pests of Tobacco in Cuba.]—*Circ. Estac. exp. agron. Santiago de las Vegas* no. 80 51 pp., 10 pls. Santiago de las Vegas, June 1936. [Recd. October 1936.]

An account is given of the bionomics and control of the chief pests of tobacco in Cuba. They include *Heliothis virescens*, F., *Feltia annexa*, Treit., *F. malefida*, Gn., *Protoparce* (*Phlegethontius*) *sexta jamaicensis*, Btlr., *Prodenia ornithogalli*, Gn., *P. dolichos*, F., *P. latifascia*, Wlk., *Xylomyges* (*P.*) *eridania*, Cram., *Psara* (*Pachyzancla*) *periusalis*, Wlk., *Phthorimaea operculella*, Zell., wireworms, of which *Heteroderes laurenti*, Guér., is the commonest, *Epitrix parvula*, F., *Pachnaeus litus*, Germ., various Gryllids, *Cyrtopeltis varians*, Dist., and *Nezara viridula*, L.

Lasioderma serricorne, F., is the only serious pest of stored tobacco in Cuba.

KRUG (H. P.). **A podridão interna dos capulhos do algodoeiro no Estado de São Paulo.** [Internal Boll-rot of Cotton in the State of S. Paulo.]—*Bol. tech. Inst. agron. Campinas* no. 23 I 19 pp., 1 pl., 26 refs. Campinas, 1936.

MENDES (L. O. T.). **Os " manchadores " do algodão** (*Dysdercus* **spp.).** [The Cotton Stainers, *Dysdercus* spp.]—*T.c.* II 21 pp., 2 pls., 66 refs. (With Summaries in English.)

The first paper includes a review of the geographical distribution, economic importance and symptoms of internal boll-rots of cotton caused by fungi, particularly *Nematospora*, and bacteria, and an account of preliminary studies of them in São Paulo, Brazil, where they are of minor importance. The chief vectors are cotton stainers of the genus *Dysdercus*. In the second paper, the world distribution of bugs of this genus is recorded, and it is stated that about 10 species occur in Brazil and at least 3 in São Paulo. Their specific names are not given. They occur on cotton and other plants, chiefly Malvaceae, and have been found to develop from egg to adult in 5–6 weeks. An account is given of the injury to cotton caused by the associated boll-rots.

SORENSON (C. J.). **Codling Moth Flight Records in Utah Apple Orchards, 1935.**—*Leafl. Utah agric. Exp. Sta.* no. 73, 4 pp., 2 figs. Logan, Utah, May 1936. [Recd. October 1936.]

Records of the activity of adults of the codling moth [*Cydia pomonella*, L.] obtained by means of bait traps in apple orchards of north-western Utah were used for the accurate timing of spray applications in 1935. Moths of the over-wintering generation reached a peak of activity in mid-June, and those of the first brood were most abundant at the end of July. The daily catches and mean temperatures for 18 orchards are shown in graphs, and a table gives the dates for applying sprays in 5 different counties.

HEADLEE (T. J.). **Brood Study of the Codling Moth for one Decade.**—*J. econ. Ent.* **29** no. 4 pp. 639–646, 3 figs., 3 refs. Menasha, Wis., August 1936. **A Study of Codling Moth Collection and Emergence.**—*Bull. N. J. agric. Exp. Sta.* no. 605, 24 pp., 3 figs., 4 refs. New Brunswick, N.J., June 1936.

The information in these two papers on the dates of emergence of the codling moth [*Cydia pomonella*, L.] in New Jersey from July 1926 to September 1935, and the timing of sprays against it, is almost identical. The observations were made on larvae collected weekly from late June to September, and placed separately in glass vials, which were marked and put on end in a pine box, fitted with a screen wire bottom. The boxes were suspended from branches of trees in an apple orchard. It is known that moths in the boxes emerge at the same time as the bulk of the orchard population.

The period from full bloom to the beginning of emergence of the over-wintering generation during 8 of the 10 years under review ranged from 1 to 20 days, whereas in the other 2 years full bloom occurred after the adults had begun to emerge. The period from full bloom to maximum emergence (the date when 50 per cent. of the moths had emerged) ranged from 18 to 34 days. In view of these variations full bloom or blossom fall is not a satisfactory criterion for dating cover sprays.

First-generation larvae entered the apples about a week after maximum emergence of overwintered-generation adults, and second-generation larvae at the time of maximum emergence of first-generation adults. In orchards of heavy infestation in the two-brooded area of New Jersey, a few first generation larvae may start entering from a few days to nearly a week prior to the date of maximum emergence. Because of this reasonably constant relation, the date of maximum emergence is considered the best criterion for timing cover sprays. It is important to predict it in order to inform growers. It can be predicted 1–2 weeks in advance for each climatically different area by means of a codling moth emergence box, but the method is long and costly, and it is necessary to know first the average percentage of larvae that will develop into adults under the prevailing conditions. The procedure of placing emergence boxes on the tree in such positions as to represent the sunny, medium and shady sides was found to increase cost without increasing efficiency. Bait pans did not give an adequate idea of when maximum emergence had occurred or was about to occur. The use of thermal stations and calculation of the thermal constant [*R.A.E.*, A **10** 479; **17** 62; **19** 360] is economical and simple, but cannot be depended on alone. The best method appears to be the combined use of temperature accumulation stations, emergence boxes and bait pans. The emergence observed at the emergence box station is plotted against time, and temperature accumulations are plotted, also against time, at each temperature station, including the one at the box station. The emergence curve is projected in its apparently normal direction to the calculated maximum emergence, and the date noted. The curve of temperature accumulation at the same station is projected to the date predicted for maximum emergence, and the temperature accumulation on that date is noted. The temperature curves for the other stations are projected to a point where temperature accumulation is the same as that at the box station, and the date at which this temperature occurs is noted. This will be the date of maximum emergence in each case. The bait pans give an evaluation of the importance of the early emerging fringe. From these data, suitable dates for the first cover sprays can be determined. They should be applied about a week before entry of larvae into the fruit is anticipated.

The temperatures of the preceding season have apparently no practical effect on the time of emergence of the adults. Accumulations of temperature therefore begin on 1st January, but very limited amounts of day-degrees of effective temperature accumulate before 1st April. The variations of the total and partial length of codling moth generations are too large to be extinguished by the subtraction of the possible error of 6 days, due to weekly instead of daily examination, and are therefore certainly due to environmental factors. The codling moth in a given area is seldom exclusively single- or double-brooded. In each locality there are one or two less numerous groups that have more or less broods than the dominant group.

In the second paper, the dates of emergence of the moths in New Jersey from July 1926 to September 1935 are given in tables, and it is shown that hibernation in the pupal stage never occurs. Mortality in the emergence boxes during the whole period of the experiments was about 29·1 per cent. About half of the moths that may be expected to emerge do so in late summer and the remainder during the subsequent spring.

HASEMAN (L.). **What is happening to the Codling Moth ?**—*J. econ. Ent.* **29** no. 4 pp. 646–648. Menasha, Wis., August 1936.

The varying intensity of infestations of apple by the codling moth [*Cydia pomonella*, L.] in Missouri since 1885 is briefly reviewed. From 1925 to 1933 infestation increased so seriously that improved control measures failed to have any effect, although toxicity studies indicated that the larvae were not developing resistance to arsenicals. The causes of this increase were, at first, bad orchard management and spraying, and neglected packing sheds, and later, subnormal rainfall and mild winters, which favoured development. The residue question further complicated the problem. The drought and heat of 1933 followed by a cold, late rainy spring somewhat reduced the numbers in well sprayed orchards, and in 1935, every material used gave fair or good control.

STEINER (L. F.) & ACKERMAN (A. J.). **Large-Scale Test of Orchard Sanitation to control Codling Moth. Progress Report.**—*J. econ. Ent.* **29** no. 4 pp. 648–653, 3 refs. Menasha, Wis., August 1936.

Experiments were carried out in southern Indiana in 1934 and 1935 on the efficiency for the control of *Cydia* (*Carpocapsa*) *pomonella*, L., of chemically treated bands and orchard sanitation, including the removal of all surface débris from the ground and of dead wood, broken branches, split pruning stubs and rough bark from the trees. A 40-acre orchard in very neglected condition was selected ; it was planted with 31-year-old apple trees, 35–40 ft. apart, with an uncultivated area 20 ft. square under each. Half of it was treated and half reserved as control. In each year clearing was completed before the emergence of the moths began ; and in 1935, all trunk cavities were covered with wire gauze. Untreated bands were placed on 4 rows of trees and 3-inch bands treated with beta-naphthol on the remaining ones. They were applied to the trunks in both years and to the larger limbs also in 1935. Clearing and banding occupied 2,100 man-hours in 1934 and 1,300 in 1935. The whole orchard received a petal-fall and 4 cover sprays of lead arsenate. In a 7-acre section of the control portion, the yield was reduced by 66–75 per cent. in 1935 by the application of a lime-sulphur spray too soon after oil.

In 1934, the treated area produced about 59 per cent. more fruit per tree than the untreated. In 1935, it produced about 19 per cent. more than the 13 acres in the control area not injured by the sprays, and the half of it farthest from the untreated trees produced 36·2 per cent. more. The clearance measures were probably responsible for this increased yield, as they repressed *Rhynchaenus* (*Orchestes*) *pallicornis*, Say (apple flea-weevil), the early attack of which, in the uncleaned area, was severe enough seriously to affect the set of the fruit. An average reduction in 1934 of 41·9 per cent. in the number of entrances by larvae of *C. pomonella* per 100 fruit may be partly attributed to the heavier crop ; the reduction per tree was only 13·5. The relative codling moth abundance in the two areas before clearing was begun is not known. In 1935, in the whole of the treated area, the number of injuries (entrances and stings) per 100 apples was reduced by 57·1 per cent. and the number per tree by 45·1 per cent. For the part of the orchard most remote from the control, the figures were respectively 64·5 and 43·2. Control during the second year may be conservatively estimated at 50 per cent. It varied considerably with the variety of

apple, possibly because some had many more low-hanging branches and cocooning places than others. In 1934, the bands captured 91,000 larvae, which is only 10 per cent. of the total number that entered the fruit in the area, but a much higher percentage of those that would have completed their life-cycle.

SHERMAN III (F.). **Eight Seasons' Tests in Codling Moth Control in Michigan.**—*J. econ. Ent.* **29** no. 4 pp. 653–655. Menasha, Wis., August 1936.

This is a brief report on tests carried out from 1928 to 1935 on the control of the codling moth [*Cydia pomonella*, L.] on apple in southern Michigan, many of the results of which have already been noticed [*R.A.E.*, A **20** 34; **21** 333]. The objects were to test lead arsenate as a basis of comparison for other sprays, to test substitutes, to co-ordinate more closely the spraying programme with the habits of the moth, and to observe the value of supplementary control measures. It was found that lead arsenate was satisfactory and that, without complications caused by the use of adhesives and spreaders, residue could be removed without injury to the fruit. Of the 12 materials tested as possible substitutes, 3 were retained, namely zinc arsenate, which is compatible with lime-sulphur, simplifies residue removal by eliminating lead, did not, in Michigan, cause serious injury to foliage, and was almost as effective as lead arsenate; calcium arsenate, which, in addition to the first three of the above qualities possesses availability and low cost, but has to be applied frequently and was only effective against moderate infestations; and a combination of summer oil and nicotine sulphate, which is fairly effective and eliminates washing, but considerably increases cost. Data on codling moth activity obtained by the operation of breeding and emergence cages, bait-pot trapping and observations of pupating larvae beneath untreated bands were of great value in timing sprays. Scraping and banding, and attention to hibernating larvae in packing sheds, etc., considerably assisted spraying in effecting control.

VINSON (C. G.). **Substitutes for Lead Arsenate in Codling Moth Sprays.** —*J. econ. Ent.* **29** no. 4 pp. 655–658, 1 ref. Menasha, Wis., August 1936.

Following a preliminary search for substitutes for lead arsenate begun in the autumn of 1933, a combination of iron and calcium arsenates and one of nicotine sulphate and a siliceous earth (Lloyd's reagent) were tested against the codling moth [*Cydia pomonella*, L.] in Missouri in 1934 and 1935. According to the analysis of a precipitate, a stable complex formation between calcium arsenate and iron arsenate was apparently obtained. This precipitate, suspended in water (1–2 lb. to 50 U.S. gals.), was sprayed during the winter on young tobacco plants and small peach trees in full leaf in a greenhouse. Adherence to the foliage was good, and there was no scorching. In the following season, 7 sprays each of this combination and of lead arsenate (1½ lb. to 50 U.S. gals. water) were applied respectively to 2 adjacent trees of a variety of apple not highly susceptible to codling moth. The new material controlled the infestation and caused no more arsenical injury than lead arsenate. The residue on the fruit sprayed with it contained about 0·021 grains arsenic trioxide per lb. fruit and a slight amount of lead, possibly partly due to lead arsenate spray drift; on the fruit

sprayed with lead arsenate, the residue contained 0·028 gr. lead and 0·013 gr. arsenic trioxide per lb. In 1935, the experiment was repeated on trees of a more susceptible variety. The new material caused severe injury to the foliage and, used both with and without an adhesive, failed to reduce the infestation below 40 per cent. Trees sprayed with lead arsenate showed an infestation of 33 per cent.

During 1934, an apple tree that had received 5 sprays of nicotine sulphate (1 pt. to 100 gals. water), combined with Lloyd's reagent to reduce the volatility of the nicotine, yielded 490 fruits, 18 per cent. of which showed injury by larvae, whereas only 9–15 per cent. of the fruit from trees sprayed with lead arsenate was injured. A good adhesive was needed. The treatment was repeated, during the following year, with the addition of an adhesive and spreading agent in some cases and of a spreader alone in others. The spray adhered much better with than without a spreader. Where the adhesive and spreading agent was used, 1,404 apples were harvested, of which 16·6 per cent. were injured, where the other spreader was used, 3,942 apples were harvested, of which 16·4 per cent. were injured. On adjacent trees, sprayed with standard lead arsenate (3 lb. to 100 U.S. gals.) the percentage of injured fruit was 16·8. It is hoped to find a cheaper infusorial earth than Lloyd's reagent. There was no difference in the quality of fruit sprayed with nicotine and with lead arsenate.

MARSHALL (G. E.). **New Method of Codling Moth Control in Theory and Practice.**—*J. econ. Ent.* **29** no. 4 pp. 669–671. Menasha, Wis., August 1936.

A programme for the application of a combined spray of lead arsenate, summer oil and soap to apple trees for the control of the codling moth [*Cydia pomonella*, L.] is recommended after 2 years' successful trials in Indiana. The object is the prevention of the entry of the first larvae, which are potentially the most dangerous. In southern Indiana, more than 99 per cent. of the adults of the overwintered brood emerge before 20th June. To prevent practically all larval entries before that date, it is necessary to apply 4 or 5 heavy cover sprays at 7–10 day intervals, beginning 7 days after the calyx spray. Studies in 1935 indicated that apple trees will tolerate this intensive treatment with no more injury than when the applications are made over the first and second brood cover-spray period. This programme fits in admirably with the control of other pests. The amount of soap used has to be varied according to the hardness of the water and the strength of Bordeaux mixture or lime-sulphur when these are used as fungicides. The combination reduced infestation from more than 125 larvae per 100 apples in 1933 to 1·63 in 1934, and the condition of fruit on other trees showed that the reduction was due to the spray and not to some other factor. Used in 1935, in an orchard that has been a commercial failure because of codling moth since 1928, it reduced infestation from 65–95 larvae and 150 " stings " per 100 apples to 1·3 larvae and 4 " stings."

HYSLOP (J. A.). **The Periodical Cicada.**—*J. econ. Ent.* **29** no. 4 pp. 671–676. Menasha, Wis., August 1936.

In view of divergent opinions expressed, it is pointed out that *Magicicada septendecim*, L., can be a serious orchard pest in outbreak

years in the United States, but is of economic importance only in the immediate vicinity of woodlands or on land that has recently been reclaimed from forest. Brief notes are given on its life-history from the time when the nymphs emerge from the ground until the new generation returns to it. Points about which little is known are indicated and suggested for investigation, such as soil and vegetation preferences, the factors governing emergence, the stimuli that lead the emerging nymphs to trees, the exact function of the sound made by the males, the final stimulus to hatching and the behaviour of the nymphs under ground.

Ball (E. D.). **Food Plants of some Arizona Grasshoppers.**—*J. econ. Ent.* **29** no. 4 pp. 679–684. Menasha, Wis., August 1936.

Brief notes are given on the food-plants of a large number of grasshoppers in Arizona, showing that many of the latter are beneficial in helping to check the weeds that spread in over-grazed ranges.

Whittington (F. B.) & Huber (L. L.). **Study of Chinch Bug Populations in Ohio.**—*J. econ. Ent.* **29** no. 4 pp. 684–686. Menasha, Wis., August 1936.

The results of studies on the relative abundance of the chinch bug [*Blissus leucopterus*, Say] in the 20 principal wheat-growing counties of Ohio, made in April and May 1935, from samples of timothy [*Phleum pratense*] selected at random, showed significant variation. Surveys in 2 counties in June pointed to a collapse of the threatened outbreak, and, in 8 counties surveyed in December, the population showed an average decrease of 75 per cent.

Ficht (G. A.). **Relative Resistance of selected Strains of Corn to European Corn Borer.**—*J. econ. Ent.* **29** no. 4 pp. 687–691, 3 refs. Menasha, Wis., August 1936.

Experiments on the resistance of certain strains of maize to the European corn borer [*Pyrausta nubilalis*, Hb.] were carried out in Michigan in 1932–33 and in Indiana in 1934–35. Resistance was calculated from the percentage of full-grown larvae resulting from an estimated number of eggs per 100 plants, rather than from the relative abundance of eggs, as the extent of oviposition is largely related to the height of the plant [*R.A.E.*, A **17** 378; **18** 75], and shorter, slow-growing strains might appear to have a resistance which they would not possess in the absence of tall strains. The significant difference was calculated by the method of L. L. Huber & J. P. Sleesman [**23** 313]. One single-cross hybrid appeared to be outstanding, but the lateness of maturity may have been partly responsible. The 4 remaining strains offering promise had all silked and tasselled from 1 to 3 days earlier.

Mathes (R.). **Three Factors affecting Laboratory Rearing of European Corn Borer Larvae.**—*J. econ. Ent.* **29** no. 4 pp. 691–697, 2 figs. Menasha, Wis., August 1936.

To develop a satisfactory technique for breeding larvae of *Pyrausta nubilalis*, Hb., intended as hosts for the rearing of certain parasites, the relative merits of different kinds of food, numbers of larvae per tray, and degrees of aeration were studied in Michigan during 1931 and 1932.

All experiments were limited to the first 20 days of growth of the larvae, as the majority of the parasites under consideration complete development within this period. In all experiments, a room-size incubator was used at a constant temperature of 80°F. and 70 per cent. relative humidity. The oviposition cage was a cardboard cylinder in which moths of both sexes were confined and in which the females laid eggs on a paper lining. The rearing trays consisted of a wooden frame 17 ins. long, 9 ins. wide and 2 ins. deep ; usually the bottom was covered with copper gauze and the top with glass on blotting paper. Food was supplied to the larvae every 5 days, 8 oz. being given at the first feeding and 12 oz. at subsequent feedings. Nothing was removed from the trays during the experiment. A preliminary trial of 23 foods, and final tests with 10, gave results in favour of 1 inch sections of green string beans for the first 2 feedings, and peas in the pod for the next 2. The ends of the pods were cut. On this diet, only 16·25 per cent. of the larvae had died at the end of 20 days, and the average weight of the surviving ones was 72 mg. To test the effect of crowding the borers, trays were supplied with 100, 150, 200, 300 and 400 eggs, ready to hatch. Mortality in 20 days was lowest (23·19 per cent.) and the larvae were heaviest (73 mg.) in the tray that contained only 100, but in that with 200 the mortality was not greatly increased. In the tray with 400, 35·84 per cent. of the larvae died and the surviving ones averaged only 47 mg. in weight. In experiments in which 6 degrees of aeration were compared, a medium amount of air circulation, obtained by the use of trays with solid tops and gauze bottoms or gauze tops and bottoms, both subjected to air currents for 8 hours a day from the fifth day of rearing, was most satisfactory. The mortality under these conditions was 16·87 and 22·62 per cent. respectively for the 2 types of tray, and the average weights of surviving larvae, 63 and 64 mg. In trays with solid tops and bottoms, mortality was 82·17 per cent., and the average weight of surviving larvae, 40 mg. ; and in trays with a gauze top and bottom, subjected to continuous air currents from the first day, the figures were respectively 79 and 33.

RITCHER (P. O.). **Larger Apple Curculio in Wisconsin.**—*J. econ. Ent.* **29** no. 4 pp. 697–701, 1 ref. Menasha, Wis., August 1936.

From studies on *Tachypterellus quadrigibbus magnus*, List (larger apple curculio), made in western Wisconsin in 1934 and 1935, the life-history is given [*cf. R.A.E.*, A **23** 359] and the nature of the injury caused by the adults to apples, resulting from spring feeding and egg punctures and from feeding in July by the new generation, is described. In each year, adults were observed to appear from petal-fall (11th and 31st May). Feeding and oviposition occupied 2–3 weeks, usually coinciding with the first prolonged period of warm weather (25th May to 10th June and 8th to 28th June). Eggs were laid in cavities eaten out in small fruits and plugged with excrement. Usually for an egg to hatch and the larva to develop, the apple must cease active growth. Development occurs mainly in fruit on the ground in the case of most varieties. Egg-laying did not influence the drop of the fruit. Under observation, 21 females laid from 2 to 116 eggs, with a mean of 39. The egg, larval, prepupal and pupal stages lasted 4–8, 30, 1–2, and 4–8 days, respectively. The new generation adults often fed at first on the fruit from which they emerged, but soon migrated to fruit on the tree and fed for 10–30 days before entering hibernation in the ground

beneath. *Microbracon tachypteri*, Mues., and *Eurytoma tylodermatis*, Ashm., were found parasitising the larvae [*cf.* **22** 533] ; in one orchard, 40–63 per cent. were parasitised. A spray of 3 lb. lead arsenate with ¼ lb. dried milk in 50 U.S. gals. water killed 27 per cent. of the weevils in the laboratory, and applied in an orchard on 2nd August reduced feeding by 65 per cent. An examination of 14 trees in the following season showed that injury to the fruit had been reduced from 25 to 7 per cent., whereas there was no reduction in untreated orchards. There was, however, an average of 0·026 grains lead and 0·01 grains arsenic per lb. fruit at harvest. Tests were made with 7 different sprays, but the differences observed were not significant. Laboratory tests with oleated and iron-coated lead arsenate showed that both had a marked repellent effect. The use of a repellent to delay injury might reduce the resulting deformity. Aromatic fermenting baits were completely unsuccessful. Notes are given on the occurrence of the weevil on *Crataegus* [**24** 616].

Walkden (H. H.). **Pupal Period of the Hessian Fly.**—*J. econ. Ent.* **29** no. 4 pp. 701–704, 6 refs. Menasha, Wis., August 1936.

To obtain data on the length of the pupal period of *Mayetiola* (*Phytophaga*) *destructor*, Say, puparia were collected from wheat in Kansas just before pupation time in the autumn of 1923 and in the spring and autumn of 1924, 1927 and 1928. The ends were opened to permit observation of the larvae within. The puparia were placed in vials in which moisture conditions were made as favourable as possible and the temperature averaged slightly more than the actual outdoor temperature. Of 310 puparia collected in the autumn, 43 per cent. yielded adults, of which 72 per cent. were females.. The length of the pupal stage was 6–14 days, and the average was 11·3 at 59·6°F. and 7·5 at 66·3°. Of 260 puparia collected in the spring, 75 per cent. yielded adults, of which 54 per cent. were females. The pupal period lasted 7–33 days, with an average of 31·5 at 39·2°F., and 14·7 at 50·4°. It is thought that 73°F. approaches the temperature of aestivation, and that 39°F. approaches the development zero.

Jones (E. T.). *Hordeum* **Grasses as Hosts of the Hessian Fly.**—*J. econ. Ent.* **29** no. 4 pp. 704–710, 2 figs., 2 refs. Menasha, Wis., August 1936.

Hordeum pusillum, which is widely distributed in the United States and grows among wheat, was first observed to be a food-plant of the Hessian fly [*Mayetiola destructor*, Say] in Oklahoma in 1927. Of 250 stems, 7·6 per cent. were infested and contained 50 puparia. Of plants of this grass examined in Kansas during 1928 and 1932–34, 0–4·6 per cent. were infested. Adult flies bred on wheat and transferred, in October 1927, to thickly seeded, small, young plants of *H. pusillum*, growing in fence rows and covered with cages, oviposited, and in the following January averages of 5·6 per cent. of the plants and 1·9 per cent. of the stems were infested. The average number of puparia in an infested stem was 1·3. Spring flies produced an infestation of 40–57 per cent. of the plants and 11·2–14·7 per cent. of the stems. In various tests made with potted *H. pusillum*, the numbers of pupae obtained were 4·6–30·2 per cent. of the numbers of eggs deposited. Puparia produced on plants grown in semi-arid conditions were smaller and less

viable than those from wheat, but those from plants in moist soil were normal. *H. pusillum* was found to be slightly less attractive for oviposition than wheat, but more so than *H. jubatum* or grasses of a few other genera. Pot tests with 15 strains or species of *Hordeum* showed them all to be food-plants but to vary in susceptibility. In 1933, wheat was reinfested under difficult conditions by adults reared on *H. pusillum* and *H. jubatum*.

Lilly (J. H.). **Influence of Certain Factors on Oviposition Responses of the Cherry Case-bearer.**—*J. econ. Ent.* **29** no. 4 pp. 710–713, 4 refs. Menasha, Wis., August 1936.

The influence of fungicide residues on, and vegetative conditions of, fruit trees on the oviposition responses of *Coleophora pruniella*, Clem. (cherry case bearer) were investigated in north-eastern Wisconsin from 1933 to 1935. Unsprayed cherry trees had an average of 2·57 eggs per leaf, while trees sprayed with sulphur compounds had an average of 1·42–1·69. Trees sprayed with copper compounds, in the form of Bordeaux mixture in 5 different programmes and copper phosphate, had averages of only 0·52–1·29 eggs per leaf.

Females reared on apple and cherry were introduced respectively into 2 cages, each covering 4 young trees of different species. They preferred to oviposit on the trees that were in the most succulent condition rather than on the species on which they had been reared. Examinations of cherry trees in 1935 showed that the number of eggs per leaf was increased where additional growth was stimulated by nitrogen fertilisation and excessive pruning. Trees fertilised with 6 lb. and 3 lb. ammonium sulphate per tree, and unfertilised trees had respectively 1·4, 1·03 and 0·79 eggs per leaf. Trees fertilised with 4 lb. and 2 lb. sodium nitrate and unfertilised trees had 0·31, 0·25 and 0·22. Heavily pruned and unpruned trees had 0·82 and 0·68.

It has been observed that many leaves on heavily infested trees turn yellow and drop soon after the hatching period, when the young larvae are feeding in numbers. Since the young larvae are unable to regain the tree, this reaction reduces heavy infestation. According to counts made in 1934 on cherry and crab apple trees, yellow and partly yellow leaves averaged 2–7 times as many eggs per leaf as green leaves on the same branches.

Heal (R. E.), Schmitt (J. B.) & Ginsburg (J. M.). **Studies of certain new Wetting Agents and their Application with Insecticides and Fungicides.**—*J. econ. Ent.* **29** no. 4 pp. 714–722, 4 refs. Menasha, Wis., August 1936.

Experiments with 3 neutral wetting agents for sprays, Areskap, Aresket and Aresklene, have been in progress since 1934 [*cf. R.A.E.*, A **23** 327]. Laboratory tests showed that the 3 compounds, diluted at 1 : 200, 1 : 400, 1 : 800 and 1 : 1,600, were compatible with hard water. To wet waxy foliage required dilutions of 1 : 800 of Areskap or Aresket and 1 : 1,600 of Aresklene, as compared with 1 : 500 of coconut-oil soap. Leaves of lower interfacial tensions were thoroughly wetted by dilutions ranging from 1 : 1,600 to 1 : 2,000 of any of the 3 agents. No injury resulted to any of a large variety of trees and plants sprayed with the 3 preparations at dilutions of 1 : 800 and 1 : 400. Injury was sometimes caused to some plants by a dilution of 1 : 200. Sulphur (300 mesh) was rendered wettable by mixing 500 parts in a mortar with

1 part Aresket or Areskap. Aresket was the more efficient and even at 1 : 800 gave fairly good results. Aresklene (paste form) was less efficient. Sulphur added at the rate of 8 and 16 lb. to 100 U.S. gals. of Aresket solution (1 : 1,600, 1 : 2,000 and 1 : 3,000) was rapidly submerged without stirring. A 1 : 4,000 solution took the sulphur in very slowly. The results with Areskap and Aresklene were less satisfactory. In spray mixtures containing 3 lb. lead arsenate, 4 lb. hydrated lime and 10 lb. sulphur per 100 U.S. gals., the sulphur became readily wettable when the water contained 1 : 2,000 Aresket, but dispersion was at a considerably lower rate when the proportion was only 1 : 3,000. Stable emulsions of petroleum oils, containing 66–70 per cent. actual oil, were prepared with 0·5 per cent. Aresklene or Areskap, but Aresket proved inferior. The resultant emulsion is compatible with hard water, lime-sulphur and lead arsenate, and will keep for long periods without decomposing. The method employed was to dissolve the emulsifier in the water and gradually add the oil. Various quantities of Areskap, dissolved in oils in which it is soluble, formed a clear liquid readily miscible with soft or hard water in all proportions. The Areskap also acts as a wetting and spreading agent, but if the spray is highly diluted more may be necessary than is required to make the oil miscible.

In view of these favourable results, field experiments were carried out in New Jersey. Reference is made to Driggers' tests of Aresket as a spreader for nicotine-bentonite [**24** 532], and to the use of all three agents as wetters for derris against red mite [*Paratetranychus pilosus*, C. & F.] on apple [**24** 723]. In tests of emulsions to be used with lead arsenate for the control of the codling moth [*Cydia pomonella*, L.], 4 blocks of apples were sprayed with lead arsenate combined respectively with a commercial oil emulsion, and with home-made emulsions prepared with Areskap and Aresklene (both at 0·5 per cent. by weight) and ammonium caseinate. The 4 treatments were approximately equally effective, the blocks producing 97, 99, 99 and 98 per cent. clean fruit, respectively. In an orchard that was being treated with a spray consisting of 3 lb. lead arsenate, 10 lb. lime, and 10 lb. colloidal sulphur containing bentonite to 100 U.S. gals. water with 1 U.S. pt. fish-oil soap as a spreader, the colloidal sulphur was replaced by elemental sulphur at 10 lb. to 100 U.S. gals., in experimental blocks, and the soap by Aresket, used at 1, 2, 3 and 5 oz. per 100 U.S. gals. All concentrations except the lowest gave excessive run-off, and, in continued experiments even this concentration failed to adhere sufficiently well without the addition of a colloidal clay (Wyo-Jel) at 5 lb. per 100 U.S gals. This spray was as effective in controlling *C. pomonella* as the spray used for the main orchard, and considerably cheaper. In laboratory tests against the green apple aphis [*Aphis pomi*, DeG.], the minimum effective concentration of Aresket, in derris as a water suspension of $1\frac{1}{2}$ lb. root (4 per cent. rotenone) per 100 U.S. gals. or nicotine sulphate at 1 : 1,200, was 1 : 1,200 or 10 oz. to 100 U.S. gals. For rosy apple aphis [*Anuraphis roseus*, Baker], 1 : 1,000 was necessary. In field tests, control of both species of Aphids with derris and nicotine at the above strengths, was much better when Aresket was used at 1 : 1,000 than at lower concentrations. A review of the field results shows that 1 oz. to 100 U.S. gals. is effective in spreading stomach poison sprays, while higher concentrations cause excessive run-off. As a wetting agent for contact sprays, 10 oz. to 100 U.S. gals. is required to wet the insects.

Eddy (C. O.). **Miscible Oil Emulsifiers and Spreaders.**—*J. econ. Ent.* **29** no. 4 pp. 722–725. Menasha, Wis., August 1936.

For several years, in Kentucky, liquid emulsifiers have been made without heat and mixed with oil, carbon bisulphide, and orthodichlorobenzene, without heating or pumping. The dilutions of the emulsions in water are very stable. These emulsifiers, combined with mineral oil, were used to make stable emulsions to dip nursery stock ; they were also employed with Bordeaux mixture (6 : 6 : 100), previously stabilised with 7 oz. sugar, as a combination spray against Coccids and fungi. With carbon bisulphide and orthodichlorobenzene, they made emulsions more toxic to Lamellicorn larvae than the less stable emulsions. They were also used with kerosene as flocculators and spreaders for lead arsenate.

In the first formula developed, the emulsifier was made with the insecticide. All amounts are given throughout in percentages by weight ; the alkali is a 50 per cent. solution of potassium hydroxide. The ingredients were mixed together in the following order : mineral oil (82·5), oleic acid (8·5), phenol (1), iso-amyl alcohol (3), ethylene glycol mono-ethyl ether (1·5) and alkali (3·5). Miscible mixtures were also made with carbon bisulphide, orthodichlorobenzene or kerosene replacing the mineral oil. Cresol was successfully substituted for phenol with each insecticide. The amount of emulsifier is much lower than in many other miscible-oil formulae. A stock emulsifier was made by combining oleic acid (48·6), phenol (5·7), iso-amyl alcohol (17·1), ethylene glycol mono-ethyl ether (8·6), and alkali (20). This permitted the use of the minimum amount necessary to emulsify each insecticide. Amyl alcohol and a combination of compounds from pine distillates were tried as substitutes for iso-amyl alcohol, which is poisonous to animals, but the first produced a somewhat less stable emulsion, and great care had to be exercised to adapt the quantities of the pine distillates to the saponification number of the oil used. A formula for a simpler emulsifier is oleic acid (32·5), cresol (32·5), yarmor pine oil (10), alkali (15) and kerosene (10). About 15 per cent. of this emulsifier was used in the insecticides. Phenol was not successfully substituted for the cresol in this formula. A liquid combined spreader and emulsifier was made with oleic acid (25), yarmor pine oil (10), wood resin (25), cresol (15), alkali (20) and kerosene (5). The addition of 15–20 per cent. of the mixture to lubricating oil, kerosene, carbon bisulphide, or orthodichlorobenzene made clear miscible emulsions that were very stable when diluted. One part emulsifier spread 2,000 parts nicotine solution on Aphids on nasturtium leaves, and a high kill was obtained. In some instances, alpha terpineol was substituted for the yarmor pine oil or a portion of it, especially when the emulsifier was used with kerosene. London resin oil was very effective in place of cresol for use with kerosene, and pine tar oil for use with mineral oil. These materials were used at 25–30 per cent., the oleic acid and resin being reduced proportionately and the amount of alkali adjusted accordingly. The resin, when present in large amounts, reacted with copper and lime to form gummy compounds that damaged certain types of apparatus.

Marcovitch (S.) & Stanley (W. W.). **A new Form of Cryolite.**—*J. econ. Ent.* **29** no. 4 pp. 725–728. Menasha, Wis., August 1936.

The physical properties of Alorco cryolite [*R.A.E.*, A **24** 297] are vastly superior to those of present fluorine insecticides. It is made

from fluorides used in connection with the manufacture of aluminium and seems to be a form of sodium fluoaluminate. It is practically free from soluble sodium fluoride. Aqueous solutions of it were slightly alkaline. As a dry spray deposit, it adhered to glass far better than lead arsenate or natural cryolite when subjected to artificial rain, but was more easily removed by 1 per cent. hydrochloric acid than was lead arsenate. Applied as a spray and as a dust to a number of plants, including fruit trees and vegetables, it caused no foliage injury. It proved at least as effective as, and usually superior to, standard insecticides in spraying tests against larvae of the Colorado potato beetle [*Leptinotarsa decemlineata*, Say], and the Mexican bean beetle, *Epilachna varivestis*, Muls. (*corrupta*, Muls.) and in dusting tests against the sweet potato flea-beetle, *Chaetocnema confinis*, Crotch. In dosage tests on *Epilachna*, beans that had received Alorco at the rate of 1, 2, 3 lb. to 50 U.S. gals. and unsprayed ones had respectively 691, 295, 214 and 2,113 larvae per row.

Another compound that gave promising results against *Epilachna* was made by stirring soapstone with the quantity of commercial hydrogen fluoride necessary to combine with the Ca, Mg, Al, Fe and SiO_2. The mixture is washed with water and dried. Under these conditions it always contains about 48 per cent. fluorine, 1·86 per cent. free HF being also present.

HAWKINS (J. H.). **Relation of Oil Utilization to Wireworm Injury.**— *J. econ. Ent.* **29** no. 4 pp. 728–731. Menasha, Wis., August 1936.

Most of the wireworms that are injurious in Maine are plentiful in heavy clay soil and scarce in, or absent from, light clay loam ; soils of intermediate types contain them in limited numbers. The abundance of wireworms in a plot should be ascertained before planting, by the examination of samples of soil, taken over an area large enough to represent distribution. The number of samples necessary cannot be calculated in advance, but is greater for experimental than for practical purposes. In Maine, 8 inches was found to be an adequate depth, and samples 1 ft. square were taken. The procedure is first to examine samples of soil types favourable to wireworms, and, if they are infested, to sample progressively towards the least favourable types. When the number of wireworms present has been ascertained, suitable crops should be selected according to their safety limit (the number of wireworms per unit area beyond which excessive injury is likely to occur). The safety limits of 10 crops grown in Maine are given, from data obtained experimentally over a period of 9 years. They are, in thousands of wireworms per acre, 14 for potatoes, 125–150 for maize, 200 for other cereals and 300 or more for different leguminous crops, clovers being practically immune. The effect of migration was shown to be negligible. Resistance often depends upon the number of plants per unit area being sufficient to furnish food to the wireworms without suffering enough injury to lower the yield as a whole. To keep down injury to potatoes, the best potato soil (light loam) should be used and a green-manure crop grown when necessary ; once in three years is sufficient when the soil is in good condition. This reduces the renewal of infestation, as there are two cultivated crops in three years and, if necessary, the soil can be cultivated well into June in the year in which the green-manure crop is planted.

GOULD (G. E.). **Studies on Cucumber Beetle Control in 1935.**—*J. econ. Ent.* **29** no. 4 pp. 731–735, 2 refs. Menasha, Wis., August 1936.

Experiments on sprays and dusts for the control of the spotted and striped cucumber beetles [*Diabrotica duodecimpunctata*, F., and *D. melanocephala*, F. (*vittata*, F.)] [*R.A.E.*, A **18** 405], which do direct damage to cucumbers and also transmit bacterial wilt, were continued in Indiana in 1935, a wet year in which the beetles were abundant. In 12 small plots, 11 different materials and an untreated check were compared. The first applications were made on 23rd June, 8 days after planting and 3 days after the first plants came up and the striped cucumber beetle appeared. A uniform coating of dusts and sprays was applied over the plants. In all, 12 applications were made before 30th July. A table shows the weight of each material used, the average length of thinned plants, the percentage of wilt, the number of beetles present, both dead and alive, after the 8th application of treatment, the yield in number and weight of fruits, and in bushels per acre, and the cost of materials per acre. A dust of barium fluosilicate and clay (1 : 4) killed over half of the small plants, and one of nicotine sulphate, copper sulphate and lime ($1\frac{1}{4}$: 5 : 14) definitely retarded plant growth. Bordeaux mixture (2 : 2 : 50) with calcium arsenate (2 lb. to 50 U.S. gals.) browned the edges of the leaves, but did not noticeably check growth. Throughout the season, the plots with copper treatment were the more vigorous. Residue from the copper sprays was still noticeable at the end of the experiment. A spray of 3 lb. copper oxychloride and 2 lb. calcium arsenate in 50 U.S. gals. water undoubtedly gave the best results, allowing only 3·6 per cent. wilt and a yield of 1,147 bushels per acre. The Bordeaux mixture and calcium arsenate spray, and dusts of copper oxychloride and clay (1 : 3) combined with 1 part calcium arsenate or manganese arsenate also gave good results. In the check plot, there was 30 per cent. wilt and the yield was 399 bushels per acre. The other insecticides used were a derris dust and dusts containing calcium arsenate, zinc arsenate or cryolite with inert carriers. The increased yield in all plots except the one treated with barium fluosilicate would more than pay for the expense involved, but the cost of the derris and nicotine-copper-lime dust is exceedingly high. Sprays were cheaper than dusts but would cost rather more to apply.

The effect of 12 insecticides on plant growth was studied in another series of plots. Plants in 5 plots were much more vigorous than those receiving the remaining treatments and the check. The best material was a dust composed of calcium arsenate and gypsum (1 : 9). Dusts of calcium arsenate, sulphur and clay (1 : 1 : 3), zinc arsenate and clay (1 : 4) and calcium arsenate and clay (1 : 1) and a barium carbonate spray were also good. Both 1 : 1 and 1 : 4 dilutions of a zinc arsenite and clay dust caused severe scorching and destroyed practically all plants. Hydrated lime afforded little protection and reduced plant size.

COMPTON (C. C.). **Rôle of Light Traps in Control of Mushroom Springtail.**—*J. econ. Ent.* **29** no. 4 pp. 735–738, 1 fig., 3 refs. Menasha, Wis., August 1936.

Hypogastrura (*Achorutes*) *armata*, Nic., often becomes extremely abundant in mushroom beds in the United States. Over 200,000

individuals are not uncommonly found per cu. ft. of compost, and populations of double this density have been observed. They cause heavy losses, by feeding on the spawn piece, developing mycelium and fruiting bodies. Bottom beds, where the compost fails to heat properly, and those on the floor are the most seriously affected, as the springtails congregate there when they are driven from the upper beds by the rising temperature. The measures recommended for application against mushroom mites following peak heat [*R.A.E.*, A **23** 471] are effective for the control of springtails, but where composting is carelessly handled, the beds fail to heat properly, or springtails survive fumigation at peak heat, other means of control must be employed. A 100- or 200-watt light, with the lower part of the bulb 8 inches above a white dinner plate pressed into the compost, forms a successful trap. A little kerosene is placed in the plates, which should be about 25 ft. apart, but satisfactory results have been obtained with 200-watt lights 50 ft. apart. The springtails did not show a positive thermotropic response. After 6 hours under a 100-watt light on a bed of 30 sq. ft. area, a plate contained more than 15 million springtails. The odours produced by kerosene, paradichlorobenzene and naphthalene, substituted for light, attracted 1 per cent. as many. Springtail infestations should be located by light before the beds are spawned or before the casing soil is applied. The traps should be put in operation 5–7 days after the house has been through the heating process, and remain for 4–10 hours. The operation should be repeated after 10–14 days. The surface of the compost should be moist during trapping. Springtails are very active when the temperature is 70°F.

Tate (H. D.) & Andre (F.). **Laboratory Studies on Toxicity of Nicotine and Soap to Gladiolus Thrips and Onion Thrips,** *Taeniothrips simplex* **(Morison),** *Thrips tabaci* **Lindeman.**—*J. econ. Ent.* **29** no. 4 pp. 738–741, 2 figs., 3 refs. Menasha, Wis., August 1936.

Laboratory investigations on the toxicity to *Taeniothrips simplex*, Morison, and *Thrips tabaci*, Lind., of nicotine and soap (sodium oleate) showed that the latter species was much more susceptible than the former. The technique of the experiments is described. Concentrations are expressed in percentages signifying gm. per 100 cc. solution; when used with nicotine the concentration of soap was 0·25 per cent. A 50 per cent. mortality of *Taeniothrips simplex* was obtained with 2·6 per cent. nicotine plus soap and with 2·8 per cent. soap alone, and of *Thrips tabaci* with 0·3 per cent. nicotine plus soap and with 0·8 per cent. soap alone. A 1·5 per cent. solution of nicotine and soap killed 97 per cent. of *T. tabaci*, whereas a 7 per cent. concentration was required to kill 98 per cent. of *Taeniothrips simplex*. Sodium oleate alone (0·25 per cent.) raised the mortality of *Thrips tabaci* to 14 per cent. above the control (sprayed with water), but in the case of *Taeniothrips simplex* the mortality was not significantly altered. The addition of the sodium oleate markedly increased the toxicity of nicotine to *Thrips tabaci* but not to *Taeniothrips simplex*.

Allen (T. C.). **Toxicity of Kerosene Steepates of Derris and Pyrethrum to some Potato Insects.**—*J. econ. Ent.* **29** no. 4 pp. 742–743, 3 refs. Menasha, Wis., August 1936.

Comparative tests, in Wisconsin, of the toxicity of atomised sprays of oil containing extracts of pyrethrum or derris to adults of *Empoasca*

fabae, Harr. (potato leafhopper) and *Epitrix cucumeris*, Harr. (potato flea-beetle) showed that pyrethrum is specific to the leafhopper and derris to the beetle. Derris root (5 per cent. rotenone) or pyrethrum was added to a refined kerosene base oil at the rate of 2 lb. to 10 U.S. gals., and, after standing for 24 hours, the liquid was filtered and tested under laboratory conditions, which are described. In 24 hours, the derris killed 22·5 per cent. of the leafhoppers and 82·5 per cent. of the flea-beetles, and the pyrethrum 86·9 per cent. of the leafhoppers and 5 per cent. of the flea-beetles. Mortality among controls was 8·8 and 0 per cent. Increasing the quantities of pyrethrum or derris did not increase toxicity. Field experience has shown that pyrethrum in oil will control the potato leafhopper, but a hood is necessary to ensure a heavy concentration of mist around the plants.

Weigel (C. A.) & Nelson (R. H.). **Heat Treatments for Control of Bulb Mite on Tuberose.**—*J. econ. Ent.* **29** no. 4 pp. 744–749, 1 ref. Menasha, Wis., August 1936.

The effectiveness of hot-water and vapour heat for the control of *Rhizoglyphus hyacinthi*, Boisd. (bulb mite), which attacks the dormant rhizomes of *Polianthes tuberosa* (tuberose) when they are incompletely cured or dried, was studied in North Carolina in 1934. Hot water treatment, even at the lowest temperature tested, 110°F. for 60 minutes, and at 120°F. for 30 minutes, was completely effective against the mites and their eggs. Vapour heat at 110°F. for 60 minutes was not completely effective. At 112°F. for 60 minutes, it killed all the mites, but some eggs hatched after treatment. There was also some hatching after treatment at 118°F., for 30 minutes. The minimum effective temperatures were 114°F. for 60 minutes and 120°F. for 30 minutes. Tests on the tolerance of the flowering size rhizomes to the treatments, at temperatures from 110° to 124°F., showed that the flowering properties are not adversely affected, and the rhizomes increase normally in weight. In 1935, incomplete experiments with flowering and planting stock size rhizomes indicated the practicability of applying hot-water treatment under commercial conditions.

Morofsky (W. F.). **Survey of Insect Fauna of some Michigan Trout Streams in Connection with improved and unimproved Streams.**—*J. econ. Ent.* **29** no. 4 pp. 749–754. Menasha, Wis., August 1936.

A survey in Michigan in 1935 confirmed the findings of previous years [*R.A.E.*, A **23** 314] that improvement of trout streams is followed by an increase in insect life and a decrease in other animal life. Tables are given showing the characteristics of the streams studied, the percentage of insects among the fauna of each, and the Orders and families found.

Chandler (S. C.). **Liquid Applications to control Peach Borer and Lesser Peach Borer.**—*J. econ. Ent.* **29** no. 4 pp. 754–756. Menasha, Wis., August 1936.

During the last 3 seasons, crystalline paradichlorobenzene, as a standard, has been compared with 7 liquid treatments for the control of *Aegeria* (*Conopia*) *exitiosa*, Say (peach borer) in southern Illinois. Paradichlorobenzene in miscible oils (Dendrol and Scalecide) gave almost the same results (about 96 per cent. mortality) as the crystalline form at the same strength (1 oz. per 10-year-old peach tree). It was

prepared by dissolving 2 lb. crystals in 1 U.S. gal. oil and diluting with water so that 1 U.S. pint contained 1 oz. crystals. In soybean-oil emulsion, paradichlorobenzene at the same strength gave about 91 per cent. mortality. Oils with paradichlorobenzene at too great a dilution or without paradichlorobenzene were unsatisfactory. Liquid dichloropentane, at 2 oz. per tree by weight, gave 95 per cent. kill, but at 1 oz. was unsatisfactory. In all tests, except that of oil without paradichlorobenzene, the trees were mounded in the usual way after treatment. The practical value of using a liquid treatment has not been demonstrated.

Against *A.* (*C.*) *pictipes*, G. & R. (lesser peach borer), for which no satisfactory method of control is known, 3 of the above materials were tried, by painting them on the injured areas of the trees. The most satisfactory was paradichlorobenzene in Dendrol so diluted that 1 U.S. pt. wash contained 2 oz. crystals. This killed 82·2 per cent. A greater proportion of paradichlorobenzene might prove still more satisfactory. One U.S. pint treated 7½ trees, and the cost was low. No injury to the trees was observed in any of the experiments.

Frost (S. W.). **Tests on Baits for Oriental Fruit Moth, 1935.**—*J. econ. Ent.* **29** no. 4 pp. 757–760, 1 ref. Menasha, Wis., August 1936.

Tests, conducted as in 1934 [*R.A.E.*, A **23** 458], were made in Pennsylvania with 55 chemicals in baits for adults of *Cydia* (*Grapholitha*) *molesta*, Busck. The baits were placed in aluminium cans of 1 U.S. gal. capacity from April to July, but after this glass jars of 1 U.S. qt. capacity were substituted, and the contents were strained once a week. These jars required less water each week to keep the liquid at the proper level. Fewer moths were caught than in preceding years. The most promising chemicals, in descending order were : linolic acid ; acetic acid ; anisic aldehyde ; oleic acid, U.S.P. ; eugenol ; anisic acid ; oleic acid, linolic free ; anethol ; safrol ; and linseed oil. Commercial oleic acid was much less attractive than oleic acid, linolic free, although linolic acid was more so, and linseed oil was among the most attractive. Poor results obtained with linalool and propyl acetate, which were very satisfactory in 1934, may be due to seasonal variations. Eucalyptol, linalyl acetate and cinnamene, which were tested over a short period, showed some promise.

Worthington (A. D.) & Decker (G. C.). **Fighting Chinch Bugs in Iowa.**—*J. econ. Ent.* **29** no. 4 pp. 760–764. Menasha, Wis., August 1936.

An account is given of the campaign in Iowa against the outbreak of the chinch bug [*Blissus leucopterus*, Say] that began in 1932. Satisfactory results were obtained with creosote-treated paper barriers [*R.A.E.*, A **22** 648] in 1934 and 1935. In 1933, 1934 and 1935, 100,000, 3,200,000 and 50,000 U.S. gals. of creosote and gas tar were used in constructing 500, 5,000 and 300 miles of barriers for the protection of 300,000, 2,400,000 and 25,000 acres of maize, and saved crops valued at about £1,200,000, £3,000,000 and £75,000, respectively.

Section of Plant Quarantine and Inspection.—*J. econ. Ent.* **29** no. 4 pp. 766–790, 3 figs. Menasha, Wis., August 1936.

This section includes the following papers : Recent Developments in Canadian Regulatory Work, by L. S. McLaine (pp. 766–771) ; Recent

Work in Control of Gypsy Moth and Brown Tail Moth, by A. F. Burgess (773–778), which describes work done under special grants, since August 1933, to reduce infestation by the gipsy moth [*Porthetria dispar*, L.] in, and prevent its spread westward from, the barrier zone [*R.A.E.*, A **11** 301] and its vicinity, and to control the brown-tail moth [*Nygmia phaeorrhoea*, Dön.] in the north-eastern States, mainly by destroying webs and non-economic food-plants ; Japanese Beetle in the Middle West, by J. C. Dawson (pp. 778–780), which deals with promising efforts in 1934 and 1935 to reduce an isolated infestation of *Popillia japonica*, Newm., in St. Louis, Missouri, and to prevent its spreading, by means of traps and soil treatment with 273 tons of lead arsenate ; The Chinch Bug Situation in Iowa, by C. J. Drake and G. C. Decker (pp. 781–785), in which a review is made of the outbreak in Iowa of *Blissus leucopterus*, Say, the numbers of which rose rapidly from 1931 till November 1934, and fell, by November 1935, to just above the 1933 level ; and Progress in Dutch Elm Disease Eradication, by L. H. Worthley (pp. 785–790), which combines a review of work on Dutch elm disease [caused by *Ceratostomella ulmi*] up to 1934 with a progress report for 1935 [**24** 423], when a method of treating elm stumps with copper sulphate to prevent sprouting was developed.

Le Pelley (R. H.) & Sullivan (W. N.). **Toxicity of Rotenone and Pyrethrins, alone and in Combination.**—*J. econ. Ent.* **29** no. 4 pp. 791–797, 3 figs., 7 refs. Menasha, Wis., August 1936.

When atomised sprays of kerosene extract of pyrethrum are used for the control of Rhynchota on coffee in Kenya [*R.A.E.*, A **21** 265], it is necessary to collect and destroy the bugs that fall to the ground, as some of them otherwise recover from the paralysis caused by the spray. It was thought that all the paralysed bugs might be killed if rotenone were included in the spray [*cf.* B **23** 13], and tests were therefore made of the relative toxicity to house-flies [*Musca domestica*, L.] of solutions, in 95 per cent. ethyl alcohol, of rotenone and pyrethrins, and combinations of the two. The solution of pyrethrins was prepared, shortly before use, from a commercial concentrate containing 14·5 per cent. pyrethrin I and 14·7 per cent. pyrethrin II, and was made to contain 5 mg. of total pyrethrins per cc. alcohol. Preliminary tests were made to determine the concentrations of rotenone and pyrethrins that would give a mortality of house-flies varying from well below to well above 50 per cent. Five concentrations of each, giving corresponding mortalities, were selected for the final tests. They were first compared with 5 mixtures formed by combining equal parts of concentrations of rotenone and pyrethrins giving corresponding mortality, and then with mixtures containing 25 parts rotenone and 75 parts pyrethrins of such concentrations. Counts made after 3 days showed that 90 per cent. mortality was obtained with 0·35 mg. rotenone per cc. but only with 2 mg. pyrethrins. Rotenone has been found to be inferior after only 24 hours, when it has not reached the peak of its lethal effect. The two poisons were proved to be compatible in alcohol but no striking synergistic effect was produced by mixing them. The mixture composed of equal parts of rotenone and pyrethrins appeared to be significantly more effective than was expected, but the 25 : 75 mixture was not. It is still hoped that the paralysing effect of pyrethrins and the lethal effect of rotenone may be combined to advantage.

Tests of acetone extracts of the foliage, roots and stems of *Tephrosia* (*Cracca*) *vogeli* from Kenya, made up so that 1 cc. extract was equivalent to 200 mg. plant material, showed that the effectiveness of extracts of these parts decreased in the order named and that the extract of the leaves had an effect equivalent to a rotenone content in the plant material of about 2 per cent.

Snelling (R. O.). **Third Generation and Method of Migration of Chinch Bug in southwestern Oklahoma.**—*J. econ. Ent.* **29** no. 4 pp. 797–803, 1 fig., 10 refs. Menasha, Wis., August 1936.

Numerous references are given to show that it has hitherto been considered that the chinch bug [*Blissus leucopterus*, Say] has only two full generations a year, under natural conditions, over its entire range. At a station in south-western Oklahoma, however, three generations were observed in the field in 1930, 1932, 1933 and 1934, and in a cage in 1933. A description is given of the crop and weather conditions at the station, which has average annual maximum and minimum temperatures of 73° and 48°F., and is subhumid, with torrential and variable rainfall. Many graminaceous food-plants of the chinch bug are grown in the district and provide ample food throughout the season of development. In the 4 years, overwintered adults were observed to leave hibernation and oviposit on winter wheat or barley early in April. Nymphs appeared in early May, and the first generation adults migrated to young *Sorghum* and oviposited on it in late June. Second brood nymphs appeared in early July and matured and oviposited during the first weeks of August, and the third generation nymphs appeared about 15th August, fed on unharvested *Sorghum* and *Sorghum* stubble and reached the adult stage late in September or in October. They flew to wild grasses to hibernate in late October. The life-cycle in the cage was similar, but some stages were slightly retarded. It is uncertain how many generations there were in 1931, as all instars could be found throughout the growing season. Contrary to conditions in places further north where the first generation bugs have not reached the adult stage when the small grain crops mature, migration in every instance was by flight, so that creosote barriers are useless for control. The third generation does considerable damage to *Sorghum* that is late in reaching maturity. The use of resistant varieties of crops is at present the best method of keeping down injury.

Fink (D. E.) & Vivian (D. L.). **Toxicity of Certain Azo Compounds to Mosquito Larvae.**—*J. econ. Ent.* **29** no. 4 p. 804. Menasha, Wis., August 1936.

Since August 1934, the toxicity of 48 azo compounds has been tested against mosquito larvae at the beginning of the fourth instar. The compounds were dissolved in acetone and calculated portions of the solution were added to 100 cc. water containing 50 larvae. Concentrations of the various compounds producing a mortality of over 50 per cent. in 16 hours were considered effective, and in the case of very dilute solutions, further tests were made to obtain a good strength. Compounds that were ineffective at 100 parts per million were abandoned. A list is given of the 25 effective compounds with the concentrations at which each was successful.

Fink (D. E.) & Smith (L. E.). **Toxicity of Certain Organic Compounds to Culicine Mosquito Larvae.**—*J. econ. Ent.* **29** no. 4 pp. 804–805, 1 ref. Menasha, Wis., August 1936.

Since previous work was reported [*R.A.E.*, B **23** 118], some 400 organic compounds have been tested against Culicine larvae at the beginning of the fourth instar, in an endeavour to find substitutes for inorganic insecticides that may endanger human health. Calculated portions of acetone solutions of each compound and 50 larvae were added to beakers containing 100 cc. distilled water, and the whole maintained at 26°C. [78·8°F.] for 16 hours, at the end of which period counts were made. Concentrations ranging from 1 to 100 parts per million were used. A list is given of the 24 more toxic compounds, with the minimum concentrations at which 50 per cent. mortality was obtained.

Jones (S. E.). **Beet Leafhopper on Texas Spinach.**—*J. econ. Ent.* **29** no. 4 pp. 805–806. Menasha, Wis., August 1936.

A severe outbreak of *Eutettix tenellus*, Baker (beet leafhopper), transmitting curly-top in spinach, occurred in an area in south-western Texas for the first time, from January to April 1936, reducing the yield in some fields by as much as 75 per cent. H. H. P. Severin, to whom specimens of diseased spinach were sent, reported that previously non-infective beet leafhoppers, after feeding on the spinach, transferred curly-top to sugar-beet, and also that diseased table beets from the same part of Texas showed reliable symptoms of curly-top. In one field, about 60 per cent. of the early spring tomatos were killed by tomato curly-top. The disappearance of the leafhoppers in late April coincided with the beginning of a period of heavy rain following drought. It is uncertain whether they were killed by the rains or forced to migrate in search of food during the drought.

Carruth (L. A.). **Further Observations on the Oblong Leaf Weevil in western New York.**—*J. econ. Ent.* **29** no. 4 pp. 806–807. Menasha, Wis., August 1936.

In May 1934, adults of *Phyllobius oblongus*, L., were found in the United States for the first time since 1923 [*R.A.E.*, A **17** 69], when they were originally reported there. They were then present in numerous localities in north-western New York and re-appeared in the same district in 1936. They were observed to feed on the foliage of pear, apple, plum, choke cherry, strawberry and raspberry, in 1934. Pear was most severely attacked, and young foliage seemed to be preferred. Most of the injury was found in neglected orchards. Brief notes are given on the habits of *P. oblongus* in Europe.

Bottimer (L. J.). *Bruchus brachialis* **Fahraeus in Georgia.**—*J. econ. Ent.* **29** no. 4 p. 807. Menasha, Wis., August 1936.

In May 1936, adults of *Bruchus brachialis*, Fhs., were taken on *Vicia villosa* in 12 counties of North Carolina, South Carolina and Georgia not yet reported as infested [*cf. R.A.E.*, A **21** 414 ; **24** 293, etc.].

Kaston (B. J.) & Becker (W. B.). *Spathius canadensis*, **Ashm., a Parasite of** *Hylurgopinus rufipes* **(Eich.).**—*J. econ. Ent.* **29** no. 4 p. 807. Menasha, Wis., August 1936.

The Braconid parasite, *Spathius canadensis*, Ashm., was observed during investigations on the elm bark-beetle, *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., and adults have been reared from cocoons in material from western Massachusetts and various parts of Connecticut. This parasite was also reared from elm logs infested with *Magdalis barbita*, Say, and *M. armicollis*, Say, and from this and records in the literature appears to be markedly polyphagous.

Fleming (W. E.). **Preventing Injury from Japanese and Asiatic Beetle Larvae to Turf in Parks and other large Areas.**—*Circ. U.S. Dep. Agric.* no. 403, 11 pp., 5 figs., 11 refs. Washington, D.C., August 1936.

This circular, which is a revision of a previous one [*R.A.E.*, A **21** 456], deals with the use of lead arsenate for controlling infestation of turf by larvae of *Popillia japonica*, Newm., *Aserica* (*Autoserica*) *castanea*, Arrow, and *Anomala orientalis*, Waterh. The rate of application now considered necessary to destroy the larvae in established turf is 10 lb. per 1,000 sq. feet, and this should give protection for at least five years. A list is given of grasses that grow satisfactorily in treated ground.

Henderson (W. W.) & Gardner (E.). **Grasshopper Egg-deposition Survey of Utah, 1934.**—*Proc. Utah Acad. Sci.* **12** pp. 229–232. Provo, 1935. [Recd. October 1936.]

A survey of the distribution of grasshoppers and their eggs in the 29 counties of Utah in September and October 1934 showed that their numbers had decreased greatly during the preceding summer. Most of the reduction was thought to be due to the extensive use of poison bait, but it was also brought about in some districts by herding flocks of 4,000 and 5,000 turkeys through the fields. A list is given of the species collected. *Melanoplus femur-rubrum*, deG., and *M. mexicanus*, Sauss., were the most abundant, but there was evidence that *Camnula pellucida*, Scudd., *M. packardi*, Scudd., and *M. bivittatus*, Say, had been extremely numerous during the early summer. *Dissosteira carolina*, L., and *Trimerotropis vinculata*, Scudd., were widely distributed, but the latter was never sufficiently abundant to damage crops. Methods of sampling used in the survey are briefly described.

Johnson (H. W.). **Effect of Leaf-hopper Yellowing upon the Carotene Content of Alfalfa.**—*Phytopathology* **26** no. 11 pp. 1061–1063, 1 fig., 3 refs. Lancaster, Pa, November 1936.

Throughout the east and middle west of the United States the second crop of lucerne is yellowed and stunted to a greater or less extent each summer owing to the attacks of *Empoasca fabae*, Harr. The author investigated the effect of such yellowing upon the carotene content, which is recognised as a measure of the potential vitamin A activity of plant tissues. He found that fresh green lucerne contained 262 mg. carotene per kg. dry matter, while the yellowed lucerne contained

only 105 mg. After 5 months' storage, meal made from the green lucerne contained 50 mg. carotene per kg. dry matter, while that made from the yellowed lucerne contained only 28 mg.

JEWETT (H. H.). **A Leafhopper Pest of Clover and Alfalfa.**—*Circ. Ky agric. Exp. Sta.* no. 44, 7 pp., 3 figs. Lexington, Ky, April 1936. [Recd. October 1936].

In Kentucky, the mid-season generation of *Empoasca fabae*, Harr., is the most destructive to lucerne, and the second and third crops may be seriously injured. The infested plants are weakened and turn yellow. Adults first appear in numbers about 1st June, and infestation reaches a peak towards the end of July and then rapidly declines. It is thought that the sudden appearance of the adults is due to migration from the Gulf States, where the insect breeds on lucerne and other plants during the winter and becomes very numerous in March and April. The use of insecticides in the field is not practical, but some control is given by regulating the time of cutting the lucerne [*cf. R.A.E.*, A **22** 598].

Clover is injured in the same way as lucerne, but a strain of red clover that shows resistance to the injury and is suitable for growing in Kentucky has recently been developed.

THOMAS (F. L.). **Control of the Cotton Flea Hopper.**—*Circ. Tex. agric. Exp. Sta.* no. 77, 8 pp., 4 figs. College Station, Tex., April 1936. [Recd. October 1936.]

Notes are given on the damage caused to cotton in Texas by *Psallus seriatus*, Reut., and on its seasonal history [*cf. R.A.E.*, A **21** 655, etc.]. As a control measure, dusting with superfine sulphur [*cf.* **24** 413] is preferred to burning the cotton stalks to destroy the eggs, as the loss of organic matter exceeds the gain by egg-destruction. Strip-cultivation is recommended, and dusting with 12–20 lb. sulphur per acre, at weekly intervals for ordinary infestations, beginning as soon as it becomes evident that the plants are not putting on squares normally. Types of dusting apparatus suitable for different areas of crop are indicated.

EBELING (W.) & KLOTZ (L. J.). **The Relation of Pest Control Treatment to Water Rot of Navel Oranges.**—*Bull. Dep. Agric. Calif.* **25** no. 3 pp. 360–368, 2 figs., 4 refs. Sacramento, Calif., September 1936.

This is an account of investigations on water rot of navel oranges in California in 1936, when it caused serious losses owing to a fortnight of continuous wet weather in February. It was found that fruit that has been sprayed with oil is more affected than fumigated or untreated fruit [*cf. R.A.E.*, A **20** 569]. The severity of water rot diminishes with reduced dosages of oil in the spray. In the general area affected by water rot, the fruit that was picked later was unusually weak and a great loss was suffered by dropping. At this time, however, the drop was greater in fumigated and untreated than in sprayed groves [*cf.* **15** 604]. This may be accounted for by the prevalence of the citrus red mite [*Paratetranychus citri*, McG.] in the former groves and a resulting weakening of the fruit. It is also possible that the weak fruit may have fallen earlier in the sprayed groves because of the prevalence of water rot.

Lindgren (D. L.) & McKenzie (H. L.). **Atmospheric HCN Fumigation for Latania Scale on Avocado Fruits.**—*Bull. Dep. Agric. Calif.* **25** no. 3. pp. 369–377, 1 fig. Sacramento, Calif., September 1936.

An account is given of experiments in California on the efficiency of fumigation with hydrocyanic acid gas against *Aspidiotus lataniae*, Sign., on avocado fruit [*cf. R.A.E.*, A **24** 250] in boxes. All exposures were for 1 hour at 67–72°F. A preliminary test in a 100 cu. ft. fumigatorium with no load factor indicated that 100 per cent. kill was obtained by using 10 cc. liquid HCN. In a 450 cu. ft. room, practically gastight at atmospheric pressure, with a load of 200 boxes filled with excelsior (but without fruit, excepting what was placed in key positions for the determination of scale kill and fruit injury), the dosages used varied from 80 to 400 cc. (or from 17·7 to 88·8 cc. per 100 cu. ft.). The highest dosage was greatly in excess of that necessary to kill the scale, but it was given to determine the risk of injury to the fruits, which were mature and sound. The injury that resulted, consisting of surface pitting, was slight in view of the excessive dosage used. The lowest dosage resulted in a complete kill of the scale. Two experiments were conducted with a load of packed avocados, in which a dosage of 108 cc. per 450 cu. ft. resulted in a complete kill of the scale. As a result of all the tests, the authors conclude that the scale on avocado fruits can be killed by atmospheric fumigation, using 25 cc. liquid HCN or its equivalent per 100 cu. ft. With a load of 50 avocado boxes per 100 cu. ft., exposure should be for one hour with electric fan circulation. Subsidiary tests showed that, during the experiments, 55·5 per cent. of the gas was lost through absorption and adsorption by the boxes and excelsior, while only 4·5 per cent. of the gas was lost through leakage and adsorption to the surface of the room.

List of intercepted Plant Pests, 1935.—*S.R.A., B.E.P.Q.* [1935], 131 pp. Washington, D.C., U.S. Dep. Agric., Bur. Ent., 1936.

This list of pests intercepted on imported plants and plant products in territory belonging to the United States covers the period from 1st July 1934 to 30th June 1935. The 237 interceptions of insects made during the year from aircraft entering the United States included : *Aleurocanthus woglumi*, Ashby, on orange leaves from the Bahamas ; *Anastrepha* sp., in seed of sapote (*Lucuma* sp.) from Guatemala ; *Bephrata cubensis*, Ashm., in seed of *Spondias dulcis*, and *Selenothrips rubrocinctus*, Giard, on guavas (*Psidium guayava*), both from Cuba ; *Leucoptera coffeella*, Guér., in coffee leaves from Porto Rico ; and *Vinsonia stellifera*, Westw., on an orchid from Panama.

Flint (W. P.). **Apple Tree Borers.**—*Ill. St. hort. Soc. News Lett.* no. 7 pp. [3–4]. Salem, Ill., October 1936.

It is recommended that the flat-headed and round-headed apple tree borers [*Chrysobothris femorata*, Ol., and *Saperda candida*, F.], which have been abundant in Illinois in 1936, attacking trees up to 20 years old, should be dug out of their burrows at the base of the trunk with a knife, or probed out with copper wire. The wound should be painted with white lead or tree paint. No successful repellent wash or paint has been found, and paradichlorobenzene must not be used on apple trees as it is liable to kill them. Thorough spraying in

May of young orchards under bearing age with 4 lb. lead arsenate and 2 lb. lime in 50 U.S. gals. water helps to check *S. candida*, as the adults feed on the foliage.

Fleming (W. E.) & Baker (F. E.). **Paris Green and its Homologues as Insecticides against the Japanese Beetle.**—*J. agric. Res.* **53** no. 3 pp. 187–195, 1 fig., 5 refs. Washington, D.C., 1936.

The following is almost entirely taken from the authors' summary of a study of the relative toxicity of Paris green and ten of its homologues to adults of *Popillia japonica*, Newm. : The experiments were conducted under conditions in which the temperature, relative humidity, light and food were controlled, and beetles from the same source were used. The effectiveness of the materials as stomach poisons was determined by comparison with acid lead arsenate applied to foliage at the rate of 8 lb. to 100 U.S. gals. water and tested under the same conditions, and was expressed as the coefficient of the insecticidal action of the lead arsenate. It was found that, except in the case of rapeseed-oil green, there was a high correlation between the coefficient of effectiveness of a material and its concentration. In general, 75 per cent. or more of the variance in these coefficients could be accounted for by the change in the concentration of the materials. Acid lead arsenate was significantly more effective as an insecticide than Paris green or its homologues. Copper crotonoarsenite, which was the most effective of them, was about 73 per cent. as effective as lead arsenate. It was not significantly different in effectiveness from Paris green or copper palmitoarsenite. There was no correlation between total or water-soluble arsenious oxide content and the effectiveness of the materials. As copper lauroarsenite was significantly less effective than copper crotonoarsenite as an insecticide, but equally as effective in making the foliage unpalatable to the beetles, it is apparent that factors other than toxicity deter the beetles from feeding. As some injury to foliage was caused by Paris green and its homologues at lower concentrations than those that deterred the beetles from feeding, it is believed that these materials cannot be safely applied in their present form to control the beetle in the United States.

Fleming (W. E.) & Baker (F. E.). **Derris as a Japanese Beetle Repellent and Insecticide.**—*J. agric. Res.* **53** no. 3 pp. 197–207, 19 refs. Washington, D.C., 1936.

The following is largely taken from the authors' summary of experiments on the value of derris and its components as insecticides and repellents in sprays against adults of *Popillia japonica*, Newm. : The coefficients of effectiveness as contact insecticides were obtained in dipping tests in which the median effective concentrations were compared with that of the standard insecticide, neutral potassium oleate [*cf. R.A.E.*, A **22** 634]. Rotenone was 2·3 times as effective as potassium oleate, deguelin was equally as effective as the soap, and derris was 0·387 times as effective. When an equal weight of castor oil was added to the derris, the coefficient of effectiveness was increased to 0·556. When added to a 0·125 per cent. solution of coconut-oil soap, which alone did not kill the beetles, the effectiveness of derris was increased to 1·765 times that of potassium oleate. Thus a small quantity of soap added to the derris spray in the field may increase its effectiveness as a contact insecticide.

Derris and its components, with the possible exception of rotenone, were found to be of little value as stomach poisons against *P. japonica*. Rotenone at the rate of 4 lb. to 100 U.S. gals. was 53·4 per cent. as effective as acid lead arsenate at the rate of 8 lb. Beetles fed only slightly on foliage sprayed with derris at the rate of 2 lb. to 100 U.S. gals. water. It is apparent that the repellent action of derris can be attributed to its rotenone and deguelin content. Toxicarol, tephrosin, and the derris resin from which all crystalline substances had been removed had little deterrent effect on the insect. Under artificial conditions of heavy infestation, where the beetles were stimulated to feed and had no choice between sprayed and unsprayed foliage, derris and rotenone afforded complete protection to the fruit and foliage of apples, being superior to acid lead arsenate and the lime sprays, which have given satisfactory results under favourable field conditions. Exposure to ultra-violet light definitely reduced the value of rotenone as a stomach poison against *P. japonica*. It was not possible to detect the change in effectiveness of derris because of the low toxic value of the material. The value of derris and rotenone as repellents was only slightly reduced by exposure to ultra-violet light for 24 hours, indicating that the repellent effect is not destroyed so rapidly as the toxicity. Fish oil and tannic acid did not modify the effectiveness of derris as a stomach poison or as a repellent. Sodium silicate decomposed the derris and destroyed its value as a repellent. Derris is readily washed from foliage by water. It is believed that this mechanical loss by the action of rain, and possibly dew, is one of the most important factors limiting the effectiveness of derris sprays for the control of the beetle. Several stickers were tested, but none of them proved satisfactory.

HARTZELL (A.) & WILCOXON (F.). **Relative Toxicity of Pyrethrins I and II to Insects.**—*Contr. Boyce Thompson Inst.* **8** no. 3 pp. 183–188, 1 fig., 15 refs. Yonkers, N.Y., September 1936.

An account is given of experiments on *Aphis rumicis*, L., and house-flies (*Musca domestica*, L.), made to ascertain whether discrepancies in the findings of various investigators as to the comparative toxicity to insects of pyrethrins I and II might be due either to different susceptibilities in the insects used or to a difference in the physical state of the pyrethrins at the moment of application. A partial separation of pyrethrins I and II was effected by multiple extraction, using as solvents petroleum ether and aqueous acetic acid. Extracts were obtained in which the ratio of I to II varied from 4 to 0·047 according to the Seil method of analysis. To determine their toxicity to *A. rumicis*, acetone and a miscible oil were used as solvents for the pyrethrins with water. When acetone was used, extracts high in pyrethrin I were considerably more toxic than those high in pyrethrin II, but when a miscible oil was used, the difference in toxicity tended to disappear.

In the tests on house-flies, which were made by the Peet-Grady method, using a kerosene carrier, and a modified Nelson method [*R.A.E.*, B **25** 12], the differences in toxicity of extracts high in pyrethrin I and those high in pyrethrin II were not statistically significant.

The results indicate that even when the same insect is used the ratio of toxicity depends on the method of application. In kerosene the pyrethrins are in solution, whereas in aqueous sprays made by pouring

acetone solutions of the pyrethrins into water they are thrown out of solution, forming emulsions of varying stability, so that it further appears that the physical condition of the toxic agent is a determining factor.

[**Report on a**] **Conference on Biological Methods of controlling Insect Pests, Belleville, Ont., June 25 and 26, 1936.**—88 pp. multigraphed [Ottawa, Ont.] Dep. Agric. Ent. Br., 1936.

This is the report of a conference called to mark the occasion of the opening of the new Dominion parasite laboratory at Belleville, Ontario. It includes the text of the following papers : The Work of the Farnham House Laboratory (pp. 5–13), by W. R. Thompson ; Organisations at present functioning in the United States—both Federal and State—in Connection with Biological Control Activities (pp. 13–26), by C. P. Clausen ; A Review of Biological Control Work in California (pp. 26–44), by H. S. Smith ; The Introduction, Propagation and Distribution of Parasites in Canada (pp. 44–54), by A. B. Baird, which includes a list of parasites liberated in Canada, arranged under the pests they are intended to control and showing which are known to be established ; Plant Resistance as a Factor in the Biological Control of Insects (pp. 55–5), by W. P. Flint ; The Utilization of native Parasites (pp. 71–75), by J. J. deGryse ; Biological Control of Insects at the University (pp. 61–71), by A. Peterson ; and The Relation of Mathematics to Population Growths (pp. 76–86), by J. Stanley.

Tucker (R. W. E.). **Report on the Entomological Section for the Year ending March 21st, 1936** [**Dep. Sci. Agric. Barbados**].—*Agric. J. Barbados* **5** no. 2 pp. 67–75, 1 map. Barbados, April 1936. [Recd. October 1936.]

Figures for damage to sugar-cane in Barbados by *Diatraea saccharalis*, F., in 1935–36 were not available when this report was written, but it appeared that the release of 115 million *Trichogramma* reduced infestation below the figure to which it rose in the previous year [*R.A.E.*, A **23** 712], when only 91 million had been released and conditions were unfavourable. The Tachinid, *Lixophaga diatraeae*, Tns., was reared from stock maintained in the laboratory [*loc. cit.*], and 11,596 were liberated in a small area. Recoveries, totalling 22, were made from 3 of the 20 fields examined. This represented a parasitism of only 1·64 per cent. of the *Diatraea* recovered, in spite of favourable conditions. An increase, in one district, of injury to sugar-cane by *Diaprepes abbreviatus*, L., is attributed to inadequate cultural control measures. Adults of *Pyrophorus luminosus*, Ill., were seen in May 1935, at or near places where larvae had been placed in the soil against *Lachnosterna smithi*, Arr. [*loc. cit.*], and two larvae kept in the laboratory were still alive and apparently in good condition after being without food for at least a year. Investigations are in progress on *Euscepes batatae*, Waterh., infesting sweet potato. Infestation of cotton by *Platyedra* (*Pectinophora*) *gossypiella*, Saund., was severe in 1935, and by December the crop in many fields was worthless. The shortening of the close season for cotton from 4 to 2 months has enabled the moth to increase on the earlier plantings to the detriment of the later ones, and the damage was intensified owing to defoliation by *Alabama argillacea*, Hb., having weakened the plants so that the production of flowers and bolls was delayed and irregular.

WADLEY (F. M.). **Development-Temperature Correlation in the Green Bug,** *Toxoptera graminum.*—*J. agric. Res.* **53** no. 4 pp. 259–266, 3 graphs, 13 refs. Washington, D.C., 1936.

The following is taken from the author's summary and conclusion : A statistical analysis has been made of the rate of development of *Toxoptera graminum*, Rond., in relation to temperature. Several curves have been fitted to developmental rate and temperature, and standard errors of estimate, in thousandths of total development per day, have been calculated. It is concluded that, for the material used in this study, a straight line is definitely better than a curve of increasing steepness for representing the development-temperature relation. Considerable evidence is found that an elongate S-curve may be better than a straight line. It is possible that, with more material and greater precision, the superiority of the S-curve would be better brought out. A freehand curve of this sort has given the best fit, but a segment of a cubic parabola has also given good results.

AHMAD (T.). **The Influence of constant and alternating Temperatures on the Development of certain Stages of Insects.**—*Proc. nat. Inst. Sci. India* **2** no. 2 pp. 67–91, 7 graphs, 11 refs. Calcutta, 5th August 1936.

A detailed account is given of experiments on the influence of both constant and fluctuating temperatures on the rate of development of the pupae of Muscids [*R.A.E.*, B **25** 13] and the eggs of *Locusta migratoria migratorioides*, R. & F. The method of rearing and handling the eggs is briefly described. An almost saturated atmosphere was used, as locust eggs can only develop when the humidity is very high.

In the first series of experiments, the incubation period was studied at constant temperatures ranging from 20 to 37°C. [68 to 98·6°F.] ; it varied from a mean of 58 days at the lowest temperature to 9·42 at the highest. The theoretical threshold of development lies at 17°C. [62·6°F.]. The percentage of eggs that were viable was highest between 33 and 37°C. [91·4 and 98·6°F.] and was markedly reduced below 23°C. [73·4°F.]. In the second series, the eggs were transferred to 5°C. [41°F.] for periods varying from 1 to 16 days at different stages of their development, and kept at a constant high temperature of 27°C. [80·6°F.], 30°C. [86°F.], 33°C. or 37°C. for the remainder of the period. Since 5°C. is far below the threshold of development and there is no possibility of development taking place at this temperature, the differences between the mean periods at high temperature alone and the mean periods at the corresponding constant temperatures represent the influence of alternating temperatures. There was a definite acceleration when the eggs were exposed to the low temperature at an early stage of development and a retardation when they were so exposed after 50 per cent. of their development had taken place. The maximum acceleration occurred when they were exposed to the low temperature for 1 day ; this amounted to 17 hours at 27°C. The rate of acceleration diminished as the period exposure to cold increased, an exposure of 8 days or more resulting in marked retardation. A maximum retardation of 35·5 hours occurred when eggs were exposed for 16 days after 50 per cent. development at 30°C. The injurious effect became more marked as the difference between low and high temperature increased ; at 37°C. there was no significant acceleration in any of the experiments,

whereas in some there was a relatively well marked retardation. The percentage of viability was inversely proportional to the duration of the period at low temperature and decreased when the difference between the low and high temperature increased. Eggs kept at 5°C. for 32 days seemed to be too seriously injured to complete their development at any of the higher temperatures. In the third series, the eggs were kept for 8 hours daily at 5°C. and for the remaining 16 at 27, 30 or 37°C. In every case development was accelerated, the amount varying from 3·6 hours at 37 to 19 hours at 27°C.

The results suggest that whereas the eggs of this locust are capable of withstanding nocturnal low temperatures alternating with warm days, they are not adapted to withstanding continuous long spells of cold. The habitat of the insect is more or less tropical, the winter is passed in the adult stage and oviposition begins early in the spring. Thus the eggs are not subjected in nature to long periods of cold, but may be exposed during the night to temperatures below the threshold of development.

HUSAIN (M. A.), TREHAN (K. N.) & VERMA (P. M.). **Studies on** *Bemisia gossypiperda*, **M. & L. No. 3. Seasonal Activities of** *Bemisia gossypiperda*, **M. & L. (the White-fly of Cotton) in the Punjab.**—*Indian J. agric. Sci.* **6** pt. 4 pp. 893–903, 2 graphs, 11 refs. Delhi, August 1936.

Much of the information contained in this paper, which gives the results of observations made during 1932–33 in the Punjab on *Bemisia gossypiperda*, Misra & Lamba, in relation to its food-plants, has been noticed previously [*R.A.E.*, A **22** 200, etc.]. Factors influencing the degree of infestation of different food-plants by this Aleurodid include proximity to infested cotton fields, protection from the wind, adequate humidity, and perhaps the stage of growth of the plant. The intensity of infestation of certain of the food-plants increased sporadically and irregularly, possibly owing to microclimatic factors. During November and December 1932, the intensity of attack on potato and *Duranta plumieri* was greater than on any other food-plant. Lists of winter and spring food-plants are given, and stress is placed on the importance of winter crops and particularly weeds in harbouring the pest in winter and of cucurbits and ratoon cotton as sources of severe attack on the new cotton crop. The new cotton was attacked early in May, but the infestation spread rapidly from June, owing to multiplication as much as to seasonal migration. During this period the attack on cucurbits declined, but it continued high on ratoon cotton until the middle of July, after which date it decreased. Infestation might therefore be reduced by clean cultivation and destruction of weeds. The results of previous experiments, in which adults were transferred from one plant to another [*loc. cit.*], were confirmed. No breeding took place on *Sorghum*, which indicated that *B. gossypiperda* is not an indiscriminate feeder. Investigations on oviposition preference showed that, during the natural periods of migration, relatively more eggs were laid on melon (*Cucumis melo*) than on cotton during May, but during July oviposition increased considerably on cottons. From October onwards, oviposition decreased on cotton and increased on crucifers, potato, etc. The period most favourable for quick multiplication of the insect coincides with the period of germination and growth of the cotton crop. Investigations on relative infestation of different varieties of cotton

made during 1932–33 and based on calculations of leaf area, showed that the initial attack was comparatively more severe on indigenous varieties, but from about the middle of August the infestation increased relatively on the American varieties [*cf.* **24** 763].

A Summary of the more important Results arrived at or indicated by the Agricultural Stations and Research Officers in the Punjab during the Years 1930–31 to 1934–35.—[3] 282 pp. Lahore, Dep. Agric. Punjab, 1936.

This publication includes a summary by M. A. Husain (pp. 169–182) of the more important entomological investigations carried out in the Punjab during 1931–35. Larval parasites of *Scirpophaga nivella*, F., on sugar-cane included *Stenobracon* (*Glyptomorpha*) *deesae*, Cam., *Rhaconotus scirpophagae*, Wlkn., *Goryphus* sp., and *Elasmus zehntneri*, Ferrière. The degree of parasitism ranged from 10 to 25 per cent. and reached its maximum in October–November. Studies of *Pyrilla* sp. on sugar-cane showed that the eggs were parasitised by *Ooencyrtus papilionis*, Ashm., and *Tetrastichus pyrillae*, Crwf., and the nymphs by *Dryinus* (*Lestodryinus*) *pyrillae*, Kieff., and *Pyrilloxenus compactus*, Pierce, this Stylopid also attacking up to 100 per cent. of the adults at times. An effective measure of control was obtained by spraying with a mixture of nicotine sulphate and fish oil soap. *Sylepta derogata*, F., caused serious damage to cotton in 1933. Two parasites, *Goryphus* (*Melcha*) *nursei*, Cam., and *Phanerotoma hendecasiella*, Cam., were bred from the hibernating larvae. Methods of control consist in the destruction of the remnants of the previous year's crop, the ploughing of fields where the larvae are hibernating, and the removal of *Hibiscus esculentus*, *Althaea rosea*, and malvaceous weeds, all of which are alternative food-plants.

Leucinodes orbonalis, Gn., is a serious pest of egg-plant [*Solanum melongena*] in the Punjab between August and October. The egg, larval and pupal stages lasted 3–4, 8–26 and 6–13 days, respectively, but the larvae of the last autumn generation hibernated as such and pupated about the middle of March. Recommended control measures are the removal of infested fruits, prevention of ratooning, and deep ploughing of infested fields in January to destroy the hibernating larvae. Similar measures are applicable for the control of *Euzophera perticella*, Rag., the larvae of which feed and pupate in the stems of egg-plant. The egg, larval and pupal stages of this Pyralid lasted 3–10, 26–58 and 9–16 days, respectively, and there were 3 or 4 broods in the year.

Corbett (G. H.) & Miller (N. C. E.). **The Termite, *Microtermes pallidus* Hav., in Relation to Tea in Malaya.**—*Sci. Ser. Dep. Agric. S.S. & F.M.S.* no. 17, 12 pp., 4 pls., 6 refs. Kuala Lumpur, 1936. Price 50 *cents*.

An account is given of investigations on *Microtermes pallidus*, Hav., which has caused serious injury to tea at Serdang, F.M.S. [*R.A.E.*, A **23** 57] in areas where the land has suffered loss of fertility and where it does not retain moisture. It attacks the tea bushes by boring into the stems where they have died back, and sometimes by eating through the stems of recently planted seedlings. It only infests weakened bushes, and is particularly liable to do so when the soil is dry in order to obtain moisture. Another termite, *Termes javanicus*, Hlmgr., constructs its nests and fungus gardens in the same area as *M. pallidus*, and the latter

sometimes inhabits the cavities abandoned by it, but they only appear to come into contact with each other accidentally. Descriptions are given of eggs, workers, queens, and soldiers of both species, and of the fungus gardens of *M. pallidus*, with short notes on those of *T. javanicus*.

In Ceylon, *Calotermes militaris*, Desn., and *C. dilatatus*, Bugnion & Popoff, form their nests in those parts of the tea plant where dieback or decay has set in, entry being effected by the winged stages. *M. pallidus*, on the other hand, constructs a tunnel of soil and comminuted bark on the outside of the main stem of the tea bush up to a point where there is an area of unhealthy wood and there bores into the stem. Frequently the workers cut through the base of the stem while boring, and the branches soon break off.

Experiments on control, begun at the end of 1932, showed that only temporary protection was afforded by treatment with Paris green, lead arsenate, magnesium sulphate, paradichlorobenzene, arsenic trioxide, mercury bichloride, kainit and castor cake. The first four of these were applied to the bush itself or scattered round it in a circular trench 4 inches deep and about 16 inches in diameter and then covered with soil, the others being distributed in a trench only. Other treatments comprised the collar-pruning (sometimes leaving one shoot) of attacked bushes and treating the pruned surfaces with paraffin wax alone or mixed with sulphur, or with a mixture of Paris green, sulphur and a proprietary wound glue. In some cases, the collar-pruned bushes were covered with soil, and artificial shade, in the form of earthenware drain pipes, was provided for bushes treated with wax to prevent its melting and damaging the newly formed buds. All of these treatments were partly successful, as a number of bushes have become vigorous and have remained free from attack for 3 years, although some of the weaker ones were unable to withstand such drastic treatment. The plants used for these experiments appeared to be deficient in starch reserves.

Further experiments, begun in June 1933, showed that the use of artificial manures reduced infestation considerably. In one of them, an area of 4 acres was subdivided into $\frac{1}{4}$ acre plots, each of which was treated with $\frac{1}{2}$ cwt. superphosphate and $\frac{1}{2}$ cwt. calcium cyanamide; $\frac{1}{2}$ cwt. kainit was also applied to one half of each plot. In February 1936, infestation had been reduced from 9·7 to 1 per cent. on the plots with kainit, and from 9·15 to 1 per cent. on those without kainit. It was found that when an attacked bush was restored to a vigorous condition by the application of fertilisers, it was abandoned by termites.

KANZAWA (Y.). **An Account of the successful Control of** *Kakivoria flavofasciata* **Nagan.** [*In Japanese.*]—68 pp., 6 pls. Hyogo, Japan, Hyogo Fmrs' Soc. Taka, July 1936.

Various insecticides were tested for the control of *Kakivoria flavofasciata*, Nagano, a serious pest of persimmon in the Taka district of Hyogo Prefecture. A variety of persimmon grown in the district was badly injured by lead arsenate, but sprays of nicotine sulphate and derris with soap were harmless and very effective. The derris spray was cheaper and it was found best to apply it in mid-August.

HIROSE (K.). **On the Insect Pests of Ramie.** [*In Japanese.*]—*Insect World* **40** no. 10 pp. 351–355. Gifu, Japan, October 1936.

A list is given of the nine species of insects known to attack ramie [*Boehmeria nivea*] in Japan, with brief notes on some of them. The

Noctuid, *Cocytodes coerulea*, Gn., is the most injurious. It appears to have two generations a year, passing winter in the adult stage. Near Gifu, the larvae occur in June and from mid-August to early October, and the moths in July and late September or October. The larvae of *Vanessa* (*Pyrameis*) *indica*, Hbst., which has several generations annually and passes the winter in the adult stage, occur on ramie from June or July onwards.

Noble (N. S.) **The Citrus Gall Wasp** (*Eurytoma fellis* **Girault**).—*Sci. Bull. Dep. Agric. N.S.W.* no. 53, 41 pp., 18 figs., 10 refs. Sydney, May 1936.

A detailed account is given of an investigation carried out in Sydney during 1931–34 on the bionomics of *Eurytoma fellis*, Gir. [*cf. R.A.E.*, A **22** 251]. Descriptions are given of the adults of both sexes and of the eggs and four larval instars. The following is based on the author's summary. *E. fellis* causes severe galling of *Citrus* in the coastal regions of southern Queensland and northern New South Wales, where the rainfall is comparatively heavy. It is apparently a native species that first infested native plants closely allied to *Citrus*. It is at present of minor importance, as *Citrus* is not extensively cultivated in the area in which it occurs. The life-cycle is annual. The adults emerged in the spring, mainly during October. Of a total of 4,889, 63·86 per cent. were females. The adults did not live long, the average life varying from just over 5 days at 25°C. [77°F.] to about 16 days at 10–13° C. [50–55·4°F.]. Females were ready to pair and oviposit immediately after emerging, and the eggs were deposited between the bark and the wood of the spring growth of *Citrus*. Unfertilised females oviposited, producing typical galls from which only males emerged. The average number of eggs deposited per female was 108·7, 75 per cent. being laid in the first 24 hours of oviposition. Females died while still containing fully developed eggs. The maximum oviposition period was 4 days. The incubation period varied from 2 to 4 weeks, even for eggs laid on the same date. Four larval instars were observed, the larva remaining in the first for about 8 months. In the late winter it moulted to the second instar, all the later instars being of short duration. The larvae reached maturity in the early spring, the total larval period lasting about 10 months. The pupal period lasted 2–4 weeks.

The galls did not become evident for several months after oviposition, but then increased in size fairly rapidly and reached their full size in the autumn or early winter, when the larvae were still in the first instar. Investigations on the changes of the botanical units as a result of infestation from the time of oviposition until the emergence of the adults showed that excessive quantities of xylem or wood were laid down by the cambium, except in the vicinity of the larva, where a considerable volume of green cellulose-walled nutritive cells of high fluid content developed from the cambium. The contents of these nutritive cells were gradually devoured as the larvae matured. Each year more than half the gall cells contained parasites of *E. fellis*, the great majority of which were *Epimegastigmus brevivalvus*, Gir.

Harris (W. V.). **The Sisal Weevil.**—*E. Afr. agric. J.* **2** no. 2 pp. 114–126, 9 figs., 12 refs. Nairobi, September 1936.

This paper amplifies a previous circular [*R.A.E.*, A **23** 67] on *Scyphophorus acupunctatus*, Gyll., attacking sisal (*Agave sisalana*) in

Tanganyika Territory, and embodies the results of the author's observations to date. The most obvious symptom of attack is the presence in the leaves of holes 1 cm. in diameter. These are the result of the weevil boring into the hearts of plants under 2 years old when the young leaves are still unfolded. When the plants are healthy the injury does not develop further, but when growth is not vigorous, the reaction of the tissue around the perforations is not sufficiently active to prevent the entrance of rot-causing organisms. These infect the central shoot, which becomes red and soft, and the plant dies. Large suckers used for planting are more liable to serious injury than bulbils, which are damaged by the weevil penetrating between the bases of the outer leaves into the bulb, or small suckers with newly cut bases, which also attract it. Deep planting and injury to the leaf bases are, however, the primary causes of the death of the plants in many cases, and the weevil is then only a secondary pest. Large healthy sisal plants are sometimes attacked by the adults when the leaves are still more or less part of the heart or central shoot. When cut, the leaves are found to have areas of brown dried-out epidermis about 8 ins. from the base. This causes discoloration of the fibres, but actual damage to them is not considerable. This type of injury is exceptional in that it appears to depend on the population density of the weevils and not on the health of the plants. There is, however, evident varietal susceptibility to weevil injury ; *Agave amaniensis* and *Furcraea gigantea* (Mauritius hemp) growing in small plots on sisal plantations, particularly near the coast, are severely attacked, and at Amani, 2,500 to 3,000 feet higher than the sisal plantations, injury to *A. sisalana* and *A. amaniensis* is negligible, damage to *A. ingens* is more noticeable, while *Furcraea gigantea* is disfigured by large holes in nearly all the leaves.

When eggs are laid in the base of young bulbils or suckers, or in the hole made by the adult weevil in the central shoot of a larger plant, usually only one or two larvae develop, but numbers do so in plants of which the pole has been cut or in dead stumps. The eggs survive only if there is a certain amount of moisture, and the larvae also die if exposed to dry conditions. The egg, larval and pupal stages last 3–4, 28–55 and 19–36 days, respectively ; the larvae bore through the central shoot or make irregular tunnels through the tissues till full-grown, and pupate in cocoons made from fibre and leaf débris. Larvae and pupae both develop most rapidly during the rains. The adult female appears to take a minimum period of 25 days after emerging to reach sexual maturity, so that 11 weeks are needed to complete the life-cycle and there is a possibility of 4 generations a year. The length of life of the adults is not known, nor is the reproductive capacity, but 3 females averaged 62 eggs each over a period of 3 months.

The general distribution of the weevil is discussed. In Tanganyika it has now been recorded as far west as Lambeni, but the average population is greatest in the coastal belt from Moa to the Pangani River. It is least in the estates at the foot of the Usambara Mountains, where the soil is of a red lateritic type. Here termites are numerous and are active in destroying the sisal stumps. There are indications that relatively dry seasons are also periods of increased activity of the weevils, but a low average rainfall is not in itself conducive to weevil attack.

The control measures recommended are similar to those already noticed [*loc. cit.*] ; attempts to render stumps innocuous by pouring a

solution of sodium arsenite into holes made in the tops were unsuccessful as the penetration was not sufficient to render the whole stump poisonous.

RITCHIE (A. H.). **Report of the Entomologist : 1935.**—*Rep. Dep. Agric. Tanganyika 1935* pp. 95–103. Dar-es-Salaam, 1936.

In Bukoba (north-western Tanganyika), the predominant Tineid leaf-miner of coffee is *Parectopa aletreuta*, Meyr. (M. S.), and *Leucoptera coffeella*, Guér., takes second place [*cf. R.A.E.*, A **23** 664]. *P. aletreuta* has not been observed east of the lakes in the coffee areas. It attacks arabica, robusta and liberica coffee, and is also to be found on such wild rubiaceous plants as *Canthium*. Pupation takes place in a wider part of the tunnel in the parenchyma, causing marginal leaf-curl, but no silk is produced. In this area *Leucoptera daricella*, Meyr., was observed breeding freely on *Pavetta* spp. *L. coffeella* was also reared there from a common wild shrub, *Mussaenda arcuata*. *Anthores leuconotus*, Pasc., although found on coffee in the Bukoba area, is not likely to assume the same economic importance as in Kilimanjaro, as, owing to the higher rainfall, oviposition takes place well above ground level. With respect to flute-holing, the position with *Dirphya princeps*, Jord., is more satisfactory than with *D. usambica*, Kolbe, in the eastern areas, owing to stronger plant development and the multiple stem system of cultivation. Other coffee stem-borers observed included *Chlorophorus carinatus*, Aur., *Apate monacha*, F., and *Phloeobius pustulosus*, Gerst. *Stephanoderes hampei*, Ferr., was found breeding freely in the berries of wild coffee. The fact that in the Bukoba area rain falls regularly and the short showers are accompanied by strong driving gales from the north-east has the effect of clearing coffee from mealybug infestation, particularly the smaller trees. It is not known whether *Pseudococcus lilacinus*, Ckll., is an introduced pest in this area, but in addition to climatic considerations, biological factors are at work. Its introduction, if such is the case, cannot be of very recent date, but its spread may have been assisted by the expansion of the coffee industry. Predators observed attacking it were the Coccinellids, *Platynaspis marginata*, Sic., *P. salaamensis*, Weise, *Scymnus* sp. and *S. luteus*, Sic., the Cecidomyiid, *Schizobremia coffeae*, Barnes, of which as many as 20 pupae may be found along a single leaf mid-rib, the Lycaenid, *Aslauga purpurascens*, Holland, and the Noctuid, *Eublemma scitula*, Ramb. Among parasites, the most prevalent was *Anagyrus aurantifrons*, Comp., which is also parasitic on *P. perniciosus*, Newst. & Willc., on coffee in the Arusha area and on *P. citri*, Risso, on *Citrus* in South Africa. The dominant species of ant in Bukoba is *Myrmicaria natalensis*, F. Sm., which eats into most flowering plants, vegetables and field crops, and is of the mound-building habit. Without the care of this ant, the mealybugs tend to decrease in numbers. Other insects observed on coffee included the Drosophilid, *Zaprionus vittiger*, Coq., which breeds prolifically in the berries, particularly if the surface has split, *Xyleborus aegir*, Egg., which infests injured parts of the stems, and *Bostrychopsis villosula*, Lesne, which occasionally bores in dry stems and branches.

In the Kilimanjaro area parasites of Trypetids on coffee included species of *Isurgus*, *Microbracon*, *Opius*, *Biosteres*, *Eupelmus* and *Sphegigaster*. The three predominant Trypetids were *Ceratitis capitata*, Wied., *C. rosa*, Ksch., and *C.* (*Trirhithrum*) *nigerrima*, Bezzi. Coffee

berries were also attacked by the Acridids, *Cyrtacanthacris tatarica*, L., and *Acanthacris ruficornis*, F., in search of water. *Asterolecanium coffeae*, Newst., first recorded in the area in 1934 [**23** 664], was observed in two further districts. *Cerococcus hibisci*, Green, which did damage in 1926 [**15** 326], was also observed.

Much injury was done to cotton by *Helopeltis* and a recrudescence of *Apion xanthostylum*, Wagn., was observed, owing to insufficient attention to "dead-season" sanitation. Its wild food-plant is not yet known, but that of *Platyedra gossypiella*, Saund., in Tanganyika is *Hibiscus esculentus*. Parasites of *P. gossypiella* there include *Microbracon kirkpatricki*, Wlkn., *Chelonus curvimaculatus*, Cam., and *Brachymeria olethrius*, Wtstn. *A. xanthostylum* is parasitised by *Entedon* sp., and the cotton leaf-roller, *Sylepta derogata*, F., by *Microbracon recessus*, Szepl., *Apanteles sagax*, Wlkn., and *A. syleptae*, Ferrière. In the Western Province, an undescribed species of *Platyedra* and *Plemyristis oenochares*, Meyr., were reared from kidney cotton (*Gossypium brasiliense*); the latter attacks the seeds of cotton, coffee and other plants.

The dominant species of *Cylas* on sweet potato in the Bukoba area is *C. puncticollis*, Boh., while *C. formicarius*, F., is also present. They do not occur east of the lakes, where their place is taken by *C. compressus*, Hartm.

MUNRO (H. K.) & FOUCHÉ (F. A.). **A List of the Scale Insects and Mealy Bugs (Coccidae) and their Host-plants in South Africa.**—*Bull. Dep. Agric. S. Afr.* no. 158, 104 pp., 6 refs. Pretoria, 1936. Price 1*s*.

Lists are given of the Coccids of South Africa, showing their food-plants, and of the plants, showing the Coccids attacking each. Cross references from the popular names of the plants (in English and Afrikaans) are included in the plant list; the popular names of the Coccids are shown separately. A third list gives the distribution in South Africa of the Coccids that are declared pests.

SALT (G.). **Experimental Studies in Insect Parasitism. IV. The Effect of Superparasitism on Populations of** *Trichogramma evanescens*.—*J. exp. Biol.* **13** no. 3 pp. 363–375, 1 fig., 7 refs. London, July 1936.

This paper, which is the fourth of a series [*cf. R.A.E.*, A **22** 203; **23** 390], deals with experiments in superparasitism of the eggs of *Sitotroga cerealella*, Ol., by *Trichogramma evanescens*, Westw. As the eggs of *S. cerealella* can support only one, or rarely two parasites, most of those containing two and all those containing three or more are superparasitised. Details of all the experiments carried out are given in tables. The following is the author's summary: *T. evanescens* is able to distinguish healthy from parasitised hosts, and when few hosts are available, can restrain itself for 8 hours to the deposition of 5 per cent. of its available eggs. As far as is yet known, the discriminative ability is perfect; but the restraint is limited and, in a longer period of time or when several parasites are together, it breaks down and superparasitism occurs. When the superparasitism is slight and only two or three eggs are laid in a host, the competition between the parasite progeny leads to the victory and emergence of one; but when it is

severe either a dwarfed or imperfectly developed individual or none at all emerges.

As the density of parasites in a fixed population of hosts is increased, more and more superparasitism occurs, and the following effects on the populations are observed : The number of hosts that escape steadily decreases ; but even at high densities of parasites some hosts occasionally escape. The number of hosts that die without yielding either hosts or parasites steadily increases. The number of parasite progeny reaches a maximum and then decreases. The number of progeny of the individual parasites steadily decreases. An increasing proportion of the emergents are imperfectly developed. An increasing proportion of the emergents are males.

Collins (P. B.). **Household Pests. Their Habits, Prevention and Control.**—Crown 8vo, 98 pp., 6 figs. London, Sir I. Pitman & Sons, Ltd, 1936. Price 2*s.* 6*d.*

This popular account of the bionomics, prevention and control of the more common insect pests that occur indoors in Britain is intended for use in small households. Chapters are included on clothes and house moths, cockroaches, silverfish and booklice, furniture beetles, house crickets and house ants, house-flies, bed-bugs and fleas, and furniture mites. Appendices deal with the use and prices of insecticides, and the control of other pests including wasps and woodlice.

Report of the Forest Products Research Board for the year 1935.—Med. 8vo, 78 pp., 6 pls., 5 figs., refs. London, H.M.S.O., 1936. Price 2*s.*

In the section dealing with research on entomological problems (pp. 36–43), it is reported that oak sapwood immersed for 30 seconds in a 5 per cent. aqueous solution of zinc chloride or sodium fluosilicate is not rendered immune from attack by *Lyctus*. Laboratory tests indicated that it is not immune from attack 2–3 months after being dipped for 30 seconds in a mixture of creosote and kerosene (1 : 9). Larvae did not survive for more than a few weeks in oak sapwood treated by a single brush application or dipping for 10–30 seconds, with orthodichlorobenzene, creosote derivatives or low temperature tar phenols, even when a year elapsed between treatment and exposure to attack. A 5 per cent. solution of formaldehyde was completely ineffective. *Xestobium rufovillosum*, DeG., has now been reared to the second generation [*cf. R.A.E.*, A **23** 156]. Parts of the softwood block floor of a church, severely attacked by a form of dry rot, were found to have been almost eaten away by *Xestobium* larvae in the comparatively short period of 25 years [*cf. loc. cit.*].

Kozlovsky (S.). **Le cycle biologique de** *Leptinotarsa decemlineata* **Say sur différentes variétés de tomate** (*Solanum lycopersicum* **L.**).—*Rev. Zool. agric.* **35** no. 7 pp. 105–108. Bordeaux, July 1936.

Preliminary experiments in France in 1933, on the susceptibility of 29 varieties of tomatos to attack by larvae of *Leptinotarsa decemlineata*, Say, showed a certain correlation between the duration of the first three instars and the total number of adults obtained, varieties on which development was rapid producing most adults. Two varieties

were apparently resistant to larval attack, and four were particularly susceptible. There was apparently no relation between hairiness of the leaves and susceptibility.

STEINER (P.). **Beiträge zur Kenntnis der Schädlingsfauna Kleinasiens IV.** *Bothynoderes punctiventris* **Germ. als Zuckerrübenschädling in der Turkei.** [Contributions to the Knowledge of Pests in Asia Minor IV. *Cleonus punctiventris* a Pest of Sugar-beet in Turkey.] —*Z. angew. Ent.* **23** no. 3 pp. 339–369, 12 figs., 8 refs. Berlin, September 1936.

An account is given of the bionomics of *Cleonus* (*Bothynoderes*) *punctiventris*, Germ., in Anatolia, on the basis of investigations in 1933–35. This weevil is observed almost every year on sugar-beet in Anatolia and Thrace, and causes considerable injury, which varies with the rainfall during the first vegetation period of the beet.

The young adults emerge from the pupae in summer and autumn but remain in the ground until the following spring. They usually come to the surface between 20th March and 15th April, a minimum soil temperature of 10°C. [50°F.] being required. As beet is grown in rotation, they migrate to the new fields, but they do not fly there and their movements on the ground are not definitely directed to the new fields. At first more males are present, but in summer the proportion of males to females is as 5 to 8, though the males were not found to die off quickly after pairing. In the laboratory, the mating period began 2–3 weeks after emergence from the soil and lasted about 2 months. Oviposition begins in May, is at its height in June and is almost completed in July, though a few eggs are laid in August. In breeding experiments, females laid an average of about 100 eggs. A weevil consumes about 0·07–0·08 gm. of beet leaf daily, equal to 8–10 seedlings that have just unfolded the cotyledons. In the laboratory, the average life of the males was 132·2 days and of the females 134·5. The eggs hatched in 9·8–15 days at temperatures of 16–26°C. [60·8–78·8°F.]. The first young larvae occur early in July, and the first pupae and young adults are found in the ground in September. As a rule no larvae are found in November, and only very few pupae. Development is quicker in the warmer districts of western Anatolia, almost mature larvae having been seen on 8th June, but the occurrence of a second generation there has not been ascertained. No hibernation of larvae and pupae has been observed, and the adults do not remain in the soil for more than one winter. Suspension of beet cultivation for one year clears infested fields provided that other food-plants are not present.

In districts where injury regularly occurs, its extent depends on the amount of rainfall in April and May ; it would seem that over 3 ins. is required to prevent serious harm. The growth of the plants is accelerated and the fall in temperature caused by rainfall renders the weevils sluggish and less eager to feed. The amount of spring rainfall does not affect the abundance of the weevil in the following year. A temperature of 31·1°C. [87·98°F.] was found to cause most feeding and egg production. Slight atmospheric humidity increased the duration of development and egg mortality. Fungous and bacterial diseases were unimportant as natural enemies. Three species of predacious Coleoptera, *Hister bipustulatus*, Schr. (*fimetarius*, Hbst.), *Zabrus*

spinipes (*blapoides*) *rugulosus*, Kraatz, and *Carabus graecus morio*, Mannh., were found in trap-trenches, as well as some small insectivorous mammals.

Ripper (W.). **Lebensweise und Bekämpfung des Halmerdflohes (*Chaetocnema aridula* Gyllh.).** [The Biology and Control of *C. aridula*.]—*Z. angew. Ent.* **23** no. 3 pp. 370–416, 23 figs., 27 refs. Berlin, September 1936.

Unprecedented injury to winter wheat, sometimes entailing a total loss of the crop, was caused in many parts of Austria in 1933 by the larvae of *Chaetocnema aridula*, Gyll., feeding in the stems [*R.A.E.*, A **22** 229]. In subsequent years losses were confined to oats and barley. The author, who was in charge of a station specially established to study this Halticid, records in detail observations on it over 2½ years. Its distribution and importance are reviewed, and particulars are given on the outbreak in Lower Austria, which was distinguished from infestations in Russia by its extraordinary intensity and by the restriction of the injury to early sown plants. In Austria, *C. aridula* is only injurious in certain circumstances, but it is probable that it has been responsible for many instances of reduction in the cereal crop ascribed to climatic conditions.

The adults begin to emerge in mid-June and live a year. Most of them remain in the fields of wheat, barley, oats and rye until the harvest, early in July, when they migrate to maize and cultivated and meadow grasses. At the end of July they leave the maize for meadows, where their abundance begins to decrease in the second half of September. They then wander everywhere, and those that reach the newly sown winter cereals feed on them in autumn. Grass edges and ditches are also infested, and all the beetles migrate to them if the sowing of winter wheat is postponed. They become nocturnal during the summer, but resume diurnal activity at the end of September. In October they enter the ground to hibernate at a depth of about 2 inches. In spring those that have hibernated in grass edges, etc., return to the cereal fields.

Pairing began in autumn before the eggs were mature and occurred again in spring as soon as the temperature rose to 17°C. [62·6°F.]. Egg-maturation depended on the temperature sum, mature eggs being observed on 19th October with a temperature sum of 2,368 day-degrees C. In the open, oviposition was observed only in spring. The larvae, which had three instars, were present from early May to mid-June. They fed inside the wheat stems, causing pathological changes that depended on the stage of the plant when the larva entered it. Plants that had not tillered were killed. In other plants, the stem turned yellow if it had formed 1 or 2 nodes. If there were more nodes, ears were formed, and the degree to which they were affected depended on the amount of injury to the vascular bundle. The larvae pupated just below the surface of the ground, and the adults emerged after 18–21 days. The factors responsible for the severe injury to winter wheat in 1933 were the warmth of the preceding autumn, which resulted in early egg-maturation, and bad weather in spring, which delayed the growth of the plants and prevented the beetles from migrating so that oviposition was concentrated in the fields where they had hibernated. Injury to wheat may be expected if the sum of warmth from early June to the end of October exceeds 2,400 day-degrees C. and plant development lags in spring.

Experiments showed that derris dusts are effective against the beetles, though they have not been tested on a large scale. If the sowing of winter cereals is delayed until 1st October, so that all the beetles hibernate in grass edges, etc., they can be killed by applying a 3 per cent. tar-oil emulsion to the soil. As severe injury does not occur every year, however, such a change in cultivation and expense for control may not be economic. For this reason a bait-spray of 4 per cent. sugar solution containing 0·4 per cent. sodium fluoride is advised, applied at the rate of about 22 gals. per acre. Winter wheat should be sprayed in spring as soon as the females begin to feed on it in numbers, if mature eggs have been observed in autumn and winter. If the eggs are not mature when activity is resumed in spring, the summer crops should be sprayed on the appearance of many females ready to oviposit. This method was used with success on about 250 acres.

WATZL (O.). **Ueber den Lebenslauf der gemeinen Weizenhalmfliege im Hochsommer. Ein Beitrag zur Biologie in Mitteleuropa.** [The Biology of the common Wheat Stem Fly in Midsummer. A Contribution to its Biology in Central Europe.]—*Z. angew. Ent.* **23** no. 3 pp. 417–431, 6 figs., 26 refs. Berlin, September 1936.

Little definite information is available regarding the biology of *Chlorops taeniopus*, Mg., in Central Europe after the adults of the summer generation emerge from the wheat stems. They do this towards the end of July, usually just before harvest but sometimes after it. At this date the winter crops have not been sown, so that there can be no oviposition on them. The observations here recorded, which were made in Austria between 1926 and 1933, indicated that the fly has, at least normally, only two generations a year, an overwintering generation producing adults in spring, and a spring or summer generation, producing the summer (autumn) flies. The adults of the former oviposit in a few days, but those of the latter normally oviposit 1–3 months after emergence, in September and October. This delayed oviposition is possibly the result of emergence being expedited by warmth without a corresponding acceleration in the development of the reproductive organs.

SCHWERDTFEGER (F.). **Zur Kenntnis der roten Kiefernbuschhornblattwespe, *Diprion sertifer* Geoffr.** (*Lophyrus rufus* Panz.). [A Contribution to the Knowledge of *D. sertifer*.]—*Z. PflKrankh.* **46** no. 11 pp. 513–534, 8 figs., 16 refs. Stuttgart, 1936.

Following infestation by the pine moth [*Panolis flammea*, Schiff.] in 1922–24, some 10,000 acres in the Prussian forestry division of Waitze on the Polish frontier were clear felled and re-planted with pines. In 1935, when the observations here recorded were made, most of the trees were 4–8 years old and a peculiar fauna had developed, including the sawfly, *Diprion sertifer*, Geoffr., which had been increasing for 3 years and occurred over an area of about 800 acres. The district is sandy, and has a scanty rainfall, a cold winter and a dry, hot spring and summer.

From 1 to 14 eggs of *D. sertifer* were seen on infested needles, the usual number being 6 or 7. In most cases, both needles of a spur shoot were infested. From 49 to 231 eggs were found on the May

shoots, the average being 118. The eggs hatched in the second half of April at an average temperature of about 14°C. [57·2°F.] with mid-day temperatures of 20–21°C. [68–69·8°F.]. Egg mortality was estimated at less than 5 per cent. The larvae developed slowly up to early May, after which their growth proceeded regularly. The first four instars took 19, 10, 8 and 9 days, respectively. First-instar larvae gnawed indentations on the surface of the needle, those of the middle instars left only a central rib and the old larvae only a short stump. The May shoots of the current year were not touched, so that it was only exceptionally that the trees were killed. The main damage occurred between 13th and 25th May. Larval mortality was slight at first, but at the end of May a mass mortality occurred, apparently owing to a bacterial disease, possibly *Bacillus septicaemiae lophyri* [*cf. R.A.E.*, A **14** 209]. As a result, the heaviest feeding, which is due to the fourth and fifth instars, did not take place. Even extremely bad weather (rain, snow, hail and several night frosts) had little effect on the larvae [*cf.* **23** 139], and predators and parasites were unimportant.

Oudemans (A. C.). **Neues über** *Pediculoides* **Targ. Tozz. 1878.** [New Information on *Pediculoides*.]—*Festschr. 60. Geburtstage Prof. Dr. Embrik Strand* **1** pp. 391–404, 6 figs., 24 refs. Riga, 17th October 1936.

It has generally been assumed that the genus *Pediculoides* has only one species, *ventricosus*, Newp., but the author recognises several, as well as describing some new ones, for one of which he erects a new genus. Most of them are parasitic on Coleoptera, Lepidoptera and Hymenoptera. He considers that *P. ventricosus*, which was originally described from larvae of a bee and of a Hymenopterous parasite attacking them, cannot now be recognised, and that some of the records of *Pediculoides* as parasitic on *Sitotroga cerealella*, Ol., or causing dermatitis in men handling stored grain refer to *P. tritici*, Lagrèze Fossat.

Lindblom (A.). **Skadedjur i Sverige år 1935.** [Pests in Sweden during 1935.]—*Medd. Växtskyddsanst.* no. 16, 60 pp., 25 figs. Stockholm, 1936.

Lists are given of agricultural and horticultural pests reported by various observers in Sweden in 1935, with notes on their distribution and frequency. In all, 237 species were reported, including 193 insects and 21 mites. In some cases methods of control are outlined.

Ahlberg (O.) & Ingelström (E.). **Sjukdomar och skadedjur som angripa våra viktigaste lantbruks- och trädgårdsväxter.** [Diseases and Pests that attack our most important agricultural and horticultural Plants.]—*Medd. Växtskyddsanst.* no. 17, 74 pp., 8 pls., 6 refs. Stockholm, 1936.

Keys are given to the diseases and pests of cultivated plants in Sweden, arranged by plants and based on the symptoms or types of injury caused, supplemented if necessary in the case of insects by morphological characters. A brief note on control is included in each case, and further details on the preparation and use of insecticides and fungicides are appended.

Papers noticed by Title only.

Knowlton (G. F.) & Smith (C. F.). **Notes on Intermountain Aphids** [including one new species from Utah].—*Ent. News* **47** no. 8 pp. 210–213, 1 fig. Philadelphia, Pa, October 1936.

Knowlton (G. F.) & Smith (C. F.). **Aphid Studies.** [A list of records principally from the Great Basin and Rocky Mountain areas of the western United States].—*Festschr. 60. Geburtstage Prof. Dr. Embrik Strand* **1** pp. 487–492, 1 pl. Riga, 17th October 1936.

Kaston (B. J.). **The Morphology of the Elm Bark Beetle,** *Hylurgopinus* [*Hylastes*] *rufipes* **(Eichhoff).**—*Bull. Conn. agric. Exp. Sta.* no. 387 pp. 613–650, 14 figs., 52 refs. New Haven, Conn., September 1936.

Marshall (James) & Groves (K.). **Three-year Study of Calcium Arsenate for Codling Moth** [*Cydia pomonella*, L.] **Control** [on apple in Washington].—*J. econ. Ent.* **29** no. 4 pp. 658–669, 3 refs. Menasha, Wis., August 1936. [*Cf. R.A.E.*, A **24** 319, etc.]

Okamoto (G.). **On** *Phyllotreta vittata* **Fab.** [attacking crucifers in Japan]. [*In Japanese.*]—*J. Plant Prot.* **23** no. 11 pp. 860–862. Tokyo, November 1936. [*Cf. R.A.E.*, A **24** 696.]

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Leib (E.). **Das erste Jahr der Grossbekämpfungsaktion gegen die Rübenblattwanze in Sachsen.** [The first Year of the Campaign against the Beet Leaf Bug, *Piesma quadrata*, Fieb., in Saxony (with trap strips of early sown beet).]—*Kranke Pflanze* **13** nos. 9–10 pp. 158–162, 175–178, 2 pls. Dresden, September–October 1936. [*Cf. R.A.E.*, A **24** 17, 749.]

Roonwal (M. L.). **Studies on the Embryology of the African Migratory Locust,** *Locusta migratoria migratorioides* **R. & F. I.—The Early Development, with a new Theory of multi-phased Gastrulation among Insects.**—*Philos. Trans.* (B) **226** no. 538 pp. 391–421, 3 pls., 16 figs., 96 refs. London, 26th October 1936.

Tilemans (E.). **Le roténone, préparation, et usages en entomologie appliquée.** [A general review from the literature].—*Bull. Inst. agron. Gembloux* **5** no. 2 pp. 186–205, 114 refs. Gembloux, May 1936. (With Summaries in Dutch, German and English.)

Wilcoxon (F.). **The Determination of Pyrethrin I.**—*Contr. Boyce Thompson Inst.* **8** no. 3 pp. 175–181, 13 refs. Yonkers, N.Y., September 1936.

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Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE
by the South Essex Recorders, Ltd., High Road, Ilford.

(2364) Wt. P15/3619 1700 1/37 S.E.R. Ltd. Gp. 353.